Microbiologist

The magazine of the Society for Applied Microbiology ■ June 2004 ■ Vol 5 No 2 ISSN 1479-2699

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Publisher: Society for Applied Microbiology.

Editor: Anthony Hilton
a.c.hilton@aston.ac.uk

Co-editor: Lucy Harper
harperlv@aston.ac.uk

Editorial Assistant:
Anouche Newman
newmaala@aston.ac.uk

Contributions: These are always welcome and should be addressed to the Editor at: a.c.hilton@aston.ac.uk

Advertising:
Julie Wright
Telephone: 01234 326661
julie@sfam.org.uk

Art and Design & layout:
Pollard Creativity

Production and printing:
Pollard Creativity.
All technical questions should be addressed to:
sfam@pollardcreativity.co.uk
Tel: 01933 665617

Society for Applied Microbiology, The Blore Tower, The Harpur Centre, Bedford MK40 1TQ, UK

Tel: +44 (0)1234 326661
Fax: +44 (0)1234 326678
email: info@sfam.org.uk
www.sfam.org.uk

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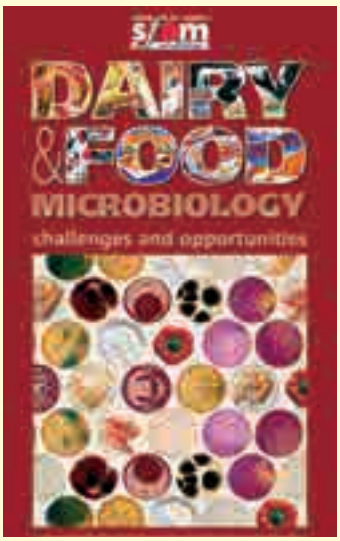

Spot the bug...

During the production of this issue a bug mysteriously invaded the Designer's workstation. Despite all our efforts to eradicate the pesky critter it remains at large...The first reader to locate the offending microbe by emailing the Editor with its precise location will a mystery prize... Email: a.c.hilton@aston.ac.uk

FEATURES

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Contact the Editor:
a.c.hilton@aston.ac.uk

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Website: the society website is a timely source of up-to-date information on all Society matters and maintains a comprehensive archive of articles and reports on a variety of microbiological topics.

www.sfam.org.uk

Editorial

GIVEN THAT MICROBIOLOGIST is published quarterly you'd think that I'd have sufficient time to compose a thoughtful editorial, but rather frustratingly for this issue, I haven't. Despite my efforts, I seem to have hit a compositional brick wall and the looming publication deadline prevents me from experimenting with mind-altering drugs to seek spiritual guidance. It makes me realise (and somewhat resent) the talent of the authors of the daily newspaper editorials but I suppose that is why they are journalists and I am a microbiologist. So, in time-honoured fashion, I'm going to use my editorial privilege for a bit of a whinge!

A year ago almost to the day the new Society website was launched and I penned an article in the June 2003 issue of *Microbiologist* to introduce all the wonderful new features available to Society members and visitors. Rather to my dismay the website has not attracted the droves of visitors I had expected. As with all major new ventures of this type there were a few teething problems, and I suspect that this contributed somewhat to the disillusionment of visitors, however I am happy to say that these have now been rectified and the website is now fully functional. If you've tried it out before and had limited success let me urge you to give it another go. If you need a username and password, be it for the first time or an updated one then please email me at a.c.hilton@aston.ac.uk and I'll send you one by return. Check out the June 2003 issue of *Microbiologist* for a review of all the great things you can do on the website or simply visit www.sfam.org.uk and have browse around. If you're unsure what services are available or how to get the most from them, please refer to the online help pages — available from *any* webpage on the site simply by passing your mouse over the 'HOME' button and then clicking the 'online Help' link.

Have *Microbiologist* will travel

I'm not really surprised anymore by the ease with which bacteria are able to spread from one place to another which made me think of an interesting and fun little experiment we could do using the *Microbiologist*. Over the next few months many of us will be taking our annual holiday, usually somewhere sunny and preferably far away from the call of the lab or office. I'm interested to see how far we can spread the magazine so please take this issue on holiday with you and send me a picture of you on holiday with the *Microbiologist*. Email your pictures to me at a.c.hilton@aston.ac.uk or mail them to the usual address detailing where in the world you and your *Microbiologist* are. The issue furthest away from our Society headquarters in Bedford will win a prize. I've no idea what the prize will be at the moment but it will be something worth winning and I've never let you down before!

Have a great vacation wherever you get to and make sure you check out the Society website soon, the web-forum in particular, as I'm getting bored of talking to myself and it's probably the reason why I've run out of things to say!

society for applied sfam microbiology

Interest Groups

Hon Meetings Secretary:

Mrs Margaret Harrison, Oxoid Ltd, Wade Road, Basingstoke RG24 8PW
Tel: +44 (0)1256 694313
Fax: +44 (0)1256 463388
margaret.harrison@oxoid.com

Bioengineering Group

Convenor: Dr Anthony Chamberlain
School of Biomedical and Life Sciences, University of Surrey, Guildford, Surrey GU2 7XH
Tel: +44 (0)1483 879718
Fax: +44 (0)1483 300374
A.Chamberlain@surrey.ac.uk

Educational Development Group

Convenor: Dr Ron Bishop
School of Applied Biological and Chemical Sciences, University of Ulster, Newtownabbey, County Antrim BT37 0QB
Tel: +44 (0)2890 366266
Fax: +44 (0)2890 366207
rh.bishop@ulst.ac.uk

Environmental Group

Convenor: Dr Keith Jones
Department of Biological Sciences, University of Lancaster, Lancaster LA1 4YQ
Tel: +44 (0)1524 593993
Fax: +44 (0)1524 843854
k.jones@lancaster.ac.uk

Food Safety and Technology Group

Convenor: Dr Jane Sutherland
Food Microbiology Unit, Dept. of Health & Human Sciences, London Metropolitan University, 166 - 200 Holloway Road, London N7 8DB
j.sutherland@londonmet.ac.uk

Infection, Prevention and Treatment Group

Convenor: Dr Susannah Walsh
School of Pharmacy & Pharmaceutical Science, Hawthorne Building, DeMontfort University, The Gateway, Leicester, LE1 9BH
SWalsh@dmu.ac.uk

Molecular Biology Group

Convenor: Dr John Coote
Division of Infection and Immunity, University of Glasgow, Joseph Black Building, Glasgow G12 8QQ
Tel: +44 (0)141 330 5845
Fax: +44 (0)141 330 4600
j.coote@bio.gla.ac.uk

COMMITTEE MEMBERS 2003 - 2004

HON PRESIDENT: **Dr Peter Silley**
Don Whitley Scientific Limited, 14 Otley Road, Shipley, West Yorks BD17 7SE
peter_silley@dwscientific.co.uk

HON GENERAL SECRETARY: **Dr Margaret Patterson**
Agriculture and Food Science Centre, Newforge Lane, Belfast BT9 5PX
margaret.patterson@dardni.gov.uk

HON MEETINGS SECRETARY: **Mrs Margaret Harrison**
G&M Procter Ltd, Arran Place, North Muirton Industrial Estate, Perth, Scotland.
margaret.harrison@oxoid.com

HON TREASURER: **Dr Valerie Edwards-Jones**
Department of Biomedical Sciences,
Manchester Metropolitan University, Manchester M1 5GD
v.e.jones@mmu.ac.uk

HON EDITOR: Journal of Applied Microbiology
Mr Alan Godfree, United Utilities Water Lingley Mere Business Park,
Great Sankey, Warrington WA5 3LP
Alan.Godfree@uuplc.co.uk

HON EDITOR: Letters in Applied Microbiology
Prof. Colin Harwood, School of Cell and Molecular Biosciences,
Medical School, Newcastle University, Framlington Place,
Newcastle upon Tyne NE2 4HH
colin.harwood@ncl.ac.uk

HON EDITOR: Microbiologist
Dr Anthony Hilton, University of Aston, Birmingham B4 7ET.
a.c.hilton@aston.ac.uk

ORDINARY COMMITTEE MEMBERS until July 2004

Dr Hilary Dodson, Department of Biomedical Sciences,
University of Bradford, Bradford, West Yorkshire
H.I.Dodson@Bradford.ac.uk

Prof. Peter Gilbert, Department of Pharmacy, University of Manchester, Manchester M13 9PL
peter.gilbert@man.ac.uk

Dr Peter Green, NCIMB Ltd., 23 St Machar Drive, Aberdeen AB2 1RY
enquiries@ncimb.uk

ORDINARY COMMITTEE MEMBERS until July 2005

Dr Julie Eastgate, Department of Biological Sciences, University of Paisley, Paisley PA1 2BE
east-bs0@wpmail.paisley.ac.uk

Dr Ian Feavers, NIBSC, Blanche Lane, South Mimms, Potters Bar, EN6 3QG
ifeavers@nibsc.ac.uk

ORDINARY COMMITTEE MEMBERS until July 2006

Dr Shona Nelson, Faculty of Applied Sciences, University of West of England, Coldharbour Lane, Bristol BS16 1QY
Shona.Nelson@uwe.ac.uk

Prof. Diane Newell, Veterinary Laboratories Agency, New Haw, Addlestone, Surrey, KT15 3NB
dnewell.cvl.wood@gtnet.gov.uk

Dr David McCleery, Dept. of Food Science (Food Microbiology), Queens University Belfast, Newforge Lane, Belfast BT9 5PX
david.mccleery@dardni.gov.uk

SOCIETY OFFICE STAFF

ACTING CHIEF EXECUTIVE OFFICER: **Dr Geraldine Schofield**
info@sfam.org.uk

MEMBERSHIP CO-ORDINATOR: **Mrs Julie Wright**
julie@sfam.org.uk

ADMINISTRATOR: **Mrs Mavis Knight**
mavis@sfam.org.uk

write to:
a.c.hilton@aston.ac.uk

Water courses

FROM: Charlotte Mizon.
SUBJECT: Microbiology Courses

I have been working for South west water for 3 years in the microbiology lab. I feel I want to further my education. Do you have any information on courses I could do, to help me expand my knowledge of microbiology/ biology. Day release/part/full time?

Alan Godfree, Hon Editor *Journal of Applied Microbiology*, replies:

In addition to studying at an academic institute you may wish to consider taking some of the short courses offered by WTI Training (http://www.wti.co.uk) and Aqua Enviro (http://www.aquaenviro.co.uk/). You should also consider becoming a member of International Water Association (http://www.iwahq.org.uk/). They operate a number of special interest groups including the Health-Related Water Microbiology group which is very active in terms of networking and specialist conferences.

Of course, the Society holds scientific meetings and conferences that often include sessions on water related microbiology.

I hope this helps, but please do not hesitate to contact me if you would like more information.

Dirty rats

FROM: Richard Manchee
SUBJECT: Bioterrorism

I have just read the article on bioterrorism by Dr Lucy Harper and would like to make a few comments about some of the content.

I am aware of the story of plague victims/body parts being catapulted over the walls of Kaffa in 1346, but knowing what we do about plague I believe that human infection resulting from this kind of action is most unlikely. Almost certainly the infection within the city walls resulted from the entry of infected rats together with their attendant population of flea vectors.

The use of airborne anthrax spores as a weapon is well known. In humans the aerosol infectious dose is thought to be about ten thousand spores but this may vary depending on the resistance of the individual exposed and the virulence of the "strain" used. Perhaps the >80% death rate in populations exhibiting symptoms after aerosol exposure should be revised following the US incidents in September 2001; prompt therapy saved 60% of those presenting with the disease. I should point out there is a vaccine available against anthrax based on the protective antigen component of the toxin complex. Studies in primates have shown that the vaccine is effective against an aerosol challenge but in recent years it has received a bad press due to its association with such conditions as "Gulf War Syndrome".

Botulism is not caused by infection with the organisms of *Clostridium botulinum*, except in the exceptional case of infant botulism. It is caused by ingestion of the toxin which has been produced by the organism in food before it is eaten. It is the toxin itself which is deployed as a weapon, not the spores of the organism (this is clarified later in the article). Iraq may have produced 11 tonnes of culture fluid in which *Cl. botulinum* had been grown but this material is only the first stage in the production of an effective weapon. A considerable degree of purification is required first.

Please believe that I am not being critical of Dr Harper's article which I found very interesting. It is just that I have worked in the field of BW defence for 25 years so I read such articles as this with a particularly keen eye.

A great microbiologist

FROM: Christopher Post
SUBJECT: Thank you letter

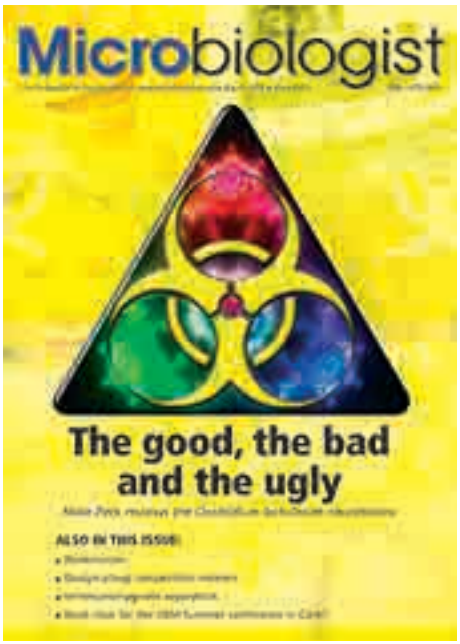
I enclose a thank you letter from my daughter Merryn Post for the generous *Design-a-bug* competition prize of the spray painting set and other SfAM materials.

Merryn wrote this unprompted and unscripted!

Symbolism

FROM: Jonathan Caddick
SUBJECT: Biohazard

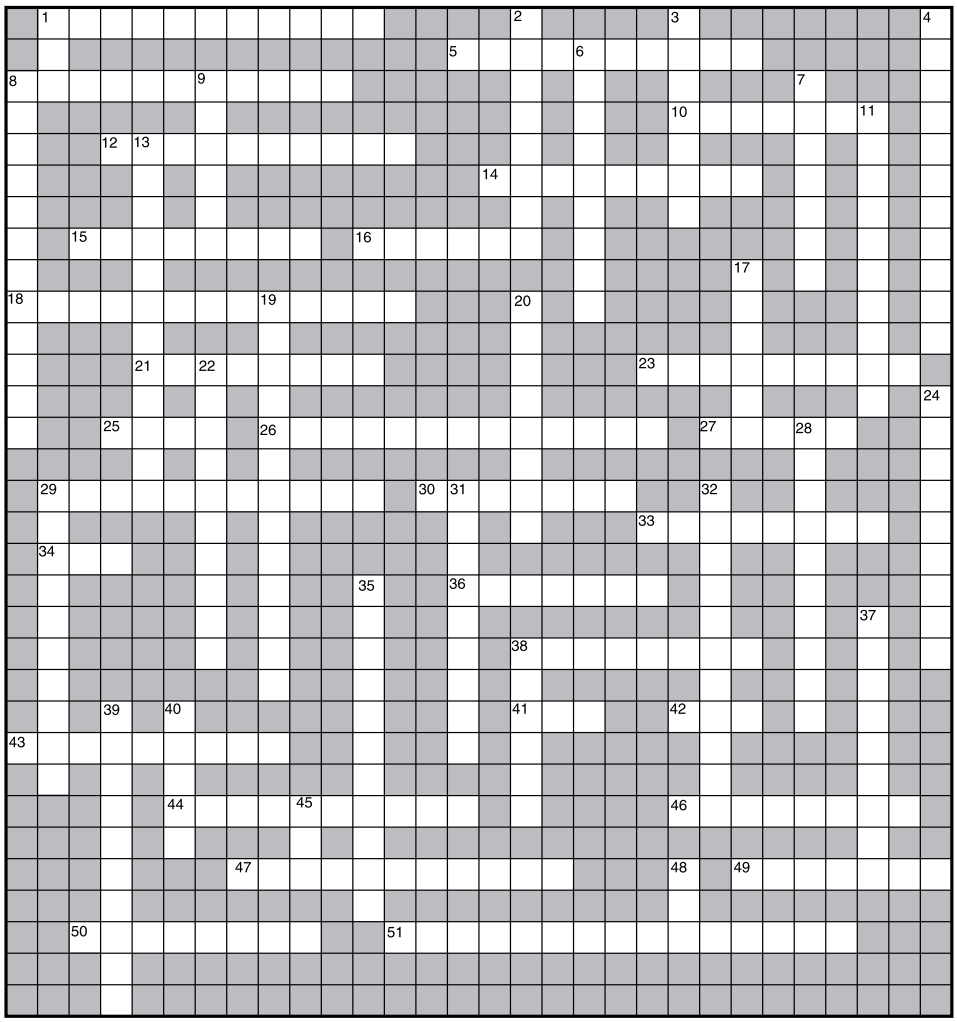
I really loved the front cover of the March issue of *Microbiologist* which made me wonder about the significance of the design of the Biohazard sign. Does anyone know its origin and if the symbol signifies anything in particular?



Bacteriology Crossword

Thank you for the many correct entries to our March **Codebreaker Quiz**. Unfortunately there can be only one winner and this time a £30 book token is on its way to **Dr A Edmondson** of Leeds Metropolitan University who correctly unscrambled the hidden phrase: ***ANTON VAN LEEUWENHOEK WAS THE FIRST TO SEE AND DESCRIBE BACTERIA IN 1674***. Congratulations!

This time we're testing your **bacteriology knowledge**. Complete the following crossword and you could win a £30 book token. Get your winning entries to the office by the 9th July to be in with a chance!



ACROSS

1. A microbe capable of growth between 45°C and 80°C.
5. The phase of the bacterial growth curve in which the rate of growth and the rate of death are equal.
8. Bacteria that possess sex pili are capable of this process involving the transfer of genetic material from one cell to another.
10. Bacteria described as coiled or wavy rods.
12. A flexible, helical shaped bacterium.
14. External cell structure that is long, thin, hairlike and flexible.
15. Cell structure that controls metabolism and reproduction.
16. A round or spherical shaped bacterium.
18. Process of bacterial reproduction.
21. Small loops of DNA occurring in the cytoplasm of the bacterial cell.
23. Inclusion (storage) granules consist of stored _____.
25. Hairlike appendages extending from the surface of the cell that function to attach bacteria to surfaces (mucus membranes).
26. The cell membrane is composed of a double layer of _____.
27. Proteins that extend through both lipid layers of the cell membrane form the _____.
29. An organism that requires a source of organic compounds.
30. In the death phase of the bacterial growth curve the rate of death is _____ than the rate of reproduction.
33. A microbe that grows in the absence of oxygen.
34. The initial phase of the bacterial growth curve in which there is no increase in the population.
36. The temperature or pH at which a microbe grows best.
38. The function of the flagella.
41. Ribosomes are composed of ___ and proteins.
42. Energy is stored in this compound.
43. A microbe that grows between 20°C and 45°C(50°C).
44. Bacterial growth is measured by an increase in the bacterial _____.
46. Cell structure that protects bacterial cells from differences in the internal and external osmotic pressure.
47. Increase in the size of a bacterial population is expressed as a _____ function.
49. Protein molecules attached to the inside surface of the cell membrane function as _____ that catalyze chemical reactions (i.e. production of energy).
50. The cell walls of Gram ____ bacteria contain many layers of murein.
51. The capsule consists of a variety of polypeptides and _____.

DOWN

1. Bacterial growth is expressed as a logarithmic exponent of ___.
2. An elongated, rod shaped bacterium.
3. A thick, gelatinous layer that adheres to the outside of the cell wall and prevents phagocytosis.
4. A bacterium that grows at pH 5 to 8.
6. Type nutrients required by autotrophic bacteria for growth.
7. Plasmids may contain genes for antibiotic resistance called _____.
8. Cell structure that controls the absorption of nutrients and elimination of wastes.
9. Organism requiring oxygen for growth.
11. Organism that utilizes nonliving organic material for growth.
13. Organism that grows between 0°C and 20°C.
17. A comma shaped bacterium.
19. Due to the presence of small pores, the cell membrane may be described as a _____ .
20. Function of the endospores.
22. A microbe that grows within a pH range of 0 to 5.
24. The filling of the cell.
28. Highly resistant, dormant structures formed within some bacteria.
29. Salt loving bacteria.
31. Sites of protein synthesis within the bacterial cell.
32. A microbe that can grow in the presence or absence of oxygen.
35. Bacteria are measured in units called _____.
37. A rigid corkscrew shaped bacterium.
38. The major component of the cell wall is a peptidoglycan called _____.
39. The study of structure.
40. The cell wall is responsible for the _____ of the bacterial cell.
45. The phase of the bacterial growth curve in which the population is rapidly increasing.
48. The genetic material in a bacterium is composed of a single strand of ___.

Thank you to **Brenda Wellmeyer** of North Harris Montgomery Community College District, Texas, USA for use of this crossword which was obtained from: http://science.nhmccd.edu/biol/wellmeyer/lectures.htm

A £30 book token is waiting for the person whose entry is drawn from the editor's lab-coat pocket first! The closing date for entries is **Friday 9th July 2004**. The answers will appear in the September 2004 issue of ***Microbiologist***.

Name: _____

Address: _____

Simply photocopy this page and send it to: 'Microbiologist Bacteriology Crossword', Society for Applied Microbiology, The Blore Tower, The Harpur Centre, Bedford MK40 1TQ, UK. **Remember, you could win a £30 Book Token!**

New Members

We would like to warmly welcome the following **new members** and hope that you will participate fully in the activities of the Society.

Australia

Miss X Tolosa

Belgium

Mr K Honraet

Denmark

Mr S K Lillevang

India

Miss P Makhija; Dr Singh Maneesha; Dr A K Senger

Ireland

Ms D Smyth

Singapore

Mr J Helong

Spain

Dr J A Santos

United Kingdom

Dr S C Andrews; Mr I A Cooper; Mr D R Corbett; Ms A M N De Rochefort; Mr M Fadairo; Mr T J Fakeye; Miss E Fellows; Mr A J Hall; Miss A Henriques; Dr J B Iverson; Mr J B James; Mr R Lakshmanan; Miss A Marietou; Dr A J McBain; Ms C McNulty; Miss Y Nagano; Mrs F E A Ordway; Dr S K Sagoo; Mr H R Sinclair; Dr T A Wood; Mr A K A Wright

USA

Mr W Khune; Dr R Narasimhan; Dr A C Rodriguez; Mr N Shah; Mr D Vogel

Dr Peter Silley reports on an exciting new project — **MED-VET-NET** — whose objective is to develop a network of excellence for the integration of veterinary, medical and food sciences in the field of food safety at a European level

No doubt a number of you will recall that in this column I have over the last twelve months mentioned SfAM involvement in MED-VET-NET. Whilst it seems in many respects to have accounted for much of my time the project is yet to be officially launched, although by the time you read this I fully expect we will be up and running. It is therefore time to say more about this truly exciting project.

The overall objective of MED-VET-NET is to develop a network of excellence for the integration of veterinary, medical and food sciences, in the field of food safety, at the European level, in order to improve research on the prevention and control of zoonoses including food borne diseases while taking into account the public health concerns of consumers and other stakeholders throughout the food chain. Alongside this primary objective are a number of secondary objectives, some of which are listed below:

1. To establish a management structure, based on a "virtual institute", which generates durable interactions between European institutes that play national central roles in zoonoses research, be it from a veterinary or a medical perspective.

2. To organise the research activities of MED-VET-NET into four scientific themes: Epidemiology, Host-Microbe Interactions, Detection and Control, Risk Assessment.

3. To initiate, plan, resource and implement scientific projects as work packages to integrate research activities related to the prevention and control of zoonoses.

4. To undertake a joint programme of activities that will ensure (a) the integration of zoonotic research activities of the partners, (b) the spreading of excellence and (c) the structured management of MED-VET-NET.

5. To promote the collaboration with scientists from additional centres of excellence within Europe but outwith MED-VET-NET.

6. To organise scientific meetings and workshops for MED-VET-NET participants only or addressing a wider audience.

7. To develop common collections of biological resources and remotely accessible databases.

8. To establish agreed procedures for the development and use of common facilities and equipment.

9. To establish a programme for the training and exchange of scientists between the MED-VET-NET Partners and to spread excellence.

10. To establish durable relationships with other relevant existing or proposed European networks.

11. To develop communications with relevant SMEs to mutual benefit.

We are all aware that diseases are naturally transmitted from animals to man, and that zoonoses, constitute major public health risks and generate emerging disease problems. Such diseases, especially when food-borne, have significant social and financial impacts in Europe and need to be addressed across the whole food supply chain.

MED-VET-NET is funded for 5 years under the EU Framework 6 Directive and comprises 16 partners made up of veterinary and public health institutes across 8 European countries. All partner institutes have national reference laboratory-based responsibilities for the prevention and control of zoonoses. The management structure of the network is based on that of a "virtual institute" and is designed to generate durable interactions between partners. Over 300 key scientists, with complementary expertises and skills, will be incorporated into the network. The combined research capabilities of these scientists has generated over 2700 peer-reviewed scientific publications in the last 5 years. The network will also generate a "cloud" of associate institutes contributing to the available expertise and enabling the spreading of excellence.

Organisational work packages will develop activities to enable integration, including structured and systematic communications, both electronically and

through meetings, and training/continuous professional development. A management project will investigate the strengths and weaknesses of, and barriers to, integrated scientific collaboration. Scientific work packages will undertake jointly executed research on zoonotic agents selected on the basis of importance in Europe and covering four thematic areas: epidemiology, host-microbe interactions, detection and control and risk analysis. Given the network structure, the technical resources and the scientific excellence it is expected that MED-VET-NET will undertake strategically-driven, state-of-art zoonoses research of world-renown quality.

So no doubt many of you will be asking just what will SfAM be doing in all this, no we are not about to develop a direct research arm but we are taking a pivotal role in this exciting venture as we have the responsibility of heading up one of the Work Packages, namely "Spreading Excellence". As the leader of this work package I will outline what we hope to achieve over the first eighteen months of the project.

The success of MED-VET-NET will be largely a reflection of the networks ability to interact with, and disseminate information to, scientists and stakeholders outside the immediate core partners. In particular the following will be targeted:

(1) other key European research scientists. (2) young research scientists. (3) non-scientific stakeholders including farmers, retailers and consumers. (4) other zoonoses institutes. (5) other related existing and proposed networks. (6) academic institutes and doctoral schools. (7) governmental and non-governmental bodies, and (8) SMEs. The assets developed by the network for dissemination will include:

New observations, data, analyses, interpretations.

Standard operating procedures and methodologies for detection and identification of zoonotic agents.

Inventories of European state-of-art research.

Databases of scientific data, expertises, research facilities.

Novel technologies and techniques for detection and control.

Training courses.

The objective of this integration activity will be to spread the excellence of knowledge encompassed within MED-VET-NET to scientists within this network as well as externally to the general public, stakeholders outside of the core network partners and the international scientific community. Appropriate structured and systematic communications will enable the successful functioning of MED-VET-NET with an environment in which the scientists can effectively and actively collaborate. This task will largely be accomplished by the setting up a Communication Unit which will provide:

Private website communication routes.

Public website communication routes, certain sectors confidential.

Part reinforcement of electronic information and communication network.

Presenting and publishing scientific results appropriately at meetings and in journals.

Establishment of communication systems within the private and public sectors.

The training of science communicators within the network.

The Communication Unit to be made up of a Communication Leader, Secretarial Support, 2 Trainee Communicators based across Europe, on 12 month contracts and rotating every 12 months such that 10 communicators will be trained over the duration of the Network and Website Staff Support

The Programme of work for the first 18 months has been broken down into separate tasks:

1. To establish an effective Communications Unit.

2. To establish an internal MED-VET-NET website module to inform about network news, scientific achievements, publish reports, notices of meetings, current issues, publications, project reports, milestones, targets, work package specific progress.

3. To establish a public website module to inform the general public, stakeholders and international scientific community outside of MED-VET-NET about scientific achievements, publish reports, open meeting agendas.

4. To develop basic information on zoonotic agents and zoonoses to be presented to the general public.

5. To assess and report on the delivery of scientific information on zoonoses to non-scientists, this task to include establishment of communication systems within the private and public sectors the training of science communicators within the network.

6. To develop a website electronic network catalogue containing associated partners (universities, other public health, veterinary and food scientists throughout Europe who will contribute to and have demonstrably benefited from association with MED-VET-NET) and other stakeholders including research institutes, academic bodies, governmental and non-governmental agencies, SMEs, food industry and retailer representative bodies and consumer councils with interests in Zoonoses.

7. To assess the options for an electronic scientific peer-reviewed journal which will be accessible for project results, surveillance studies, standardised and harmonised operating procedures, ring trials, inter-institute comparative studies, minor research projects etc.

8. To assess the options for establishing a Zoonoses Journal, as there is currently no journal which solely focuses on Zoonoses, such a journal would potentially create a future income stream to the Network.

The total budget for the whole project is in the order of 15 million euros. The Society will be receiving approximately 300,000 Euros to fund the first 18 months, these are truly exciting times as we play our part in being the voice of applied microbiology within Europe.

Further information

For more information on MED-VET-NET why not have a look at the web site at http://www.medvetnet.org/

Peter Silley

European Declaration for Microbiology

THE EUROPEAN DECLARATION FOR MICROBIOLOGY presents to the General Public, the policy makers, the scientific community and our colleagues the viewpoints and goals of FEMS.

Microbiology, the science of microbes (viruses, bacteria, algae, protozoa and fungi) has a long and continuing tradition in Europe since Antonie van Leeuwenhoek working in Delft, The Netherlands, first reported his observations of algae, bacteria and protozoa to the Royal Society of London in 1676. In the last 200 years European scientists, such as Louis Pasteur, Robert Koch, Sergei N. Winogradsky and Martinus W. Beijerinck, have made most of the seminal advances in microbiology and rate as highly as scientists in any other field of discovery. This strong tradition of excellence in European microbiology continues today, European microbiologists continue to contribute to the most important advances in medicine, agriculture, biotechnology and basic sciences.

Microbiologists worldwide have organised themselves into scientific societies. In Europe microbiology societies are fragmented by country on the one hand and by discipline on the other; they have separated into subject-related groups of virologists, bacteriologists, algologists, mycologists, protozoologists and parasitologists and into vocationally related specialities such as medical, food, agricultural, environmental and industrial microbiologists.

It is the aim of this declaration to begin a process that will provide a focus for and unify European microbiology. Only in this way can microbiologists serve our community of fellow scientists, politicians, industrialists and the general population of Europe to the best of our ability. Such cohesion will enable us to compete successfully in an international market place and to strive to lead the world in standards of scientific rigour and integrity.

Realizing that we can do more together than separately, FEMS with its 46 member societies in 35 countries spread throughout Eastern and Western Europe aims to become the nucleus for such cohesion. Let the beginning of the 21st Century and the fifth Century in modern microbiological research be the starting point for real cohesion and increased scientific cross-fertilization amongst microbiologists in Europe!

This declaration aims to initiate debate amongst European Microbiologists to establish mechanisms by which European harmonisation and, hopefully, in the future unification of microbiology can be achieved. We must do this without harming the rich diversity of microbiology in Europe. It is this diversity, which will generate tomorrow's Nobel Prize winners and stimulate the expanding influence that microbiologists should have on technological, scientific, political, social and environmental thought in Europe. FEMS believes that this declaration should specifically stimulate the following issues:

1. To ensure that Microbiology serves the welfare of mankind, allows sustainable development for all people, ensures the protection and preservation of nature and helps achieve world peace.
2. To enhance the public awareness of the benefits of microbes to the world and mankind, and the understanding that the dangers posed by microbes are few and vastly outweighed by their benefits.
3. To ensure the access of all Europeans to accurate information about microbiology, including the availability of pertinent literature, and its benefits and threats to humans and our natural environment.
4. To support the understanding and preservation of microbial biodiversity, by research and the maintenance of a network of microbial culture collections.
5. To condemn the deliberate use of microbes to the disadvantage of humans (biological warfare and bioterrorism).
6. To ensure that the teaching of microbiology should be part of all European educational systems, and be fully integrated into scientific and social education, at all levels. To encourage microbiologists to communicate with the public about their work and the importance of microbes.
7. To encourage the highest standards of safety in all microbiological processes, products and procedures. To ensure that technological advances arising from microbiological research are thoroughly tested before exploitation.
8. To make certain that microbial genomic data are to be considered the heritage of all humanity and are available to all mankind.
9. To nurture European microbiology by increasing mobility of researchers within Europe, and retaining the best microbiologists in Europe, by providing frameworks to ensure that strong microbiological research takes place in Europe in universities, hospitals, government and industrial laboratories.
10. To support the potential growth areas of microbiology such as biotechnology, food microbiology, rapid diagnostics and environmental protection.

Produced by the Federation of European Microbiological Societies for their first Congress for European Microbiologists 2003

Advertise!

With a highly targeted circulation of 2000 copies, *Microbiologist* is a cost-effective way for members and non-members to reach qualified microbiologists in industry, academia and public services, both in the UK, and worldwide.
For more information contact the Society Office or visit the following page on the Society website:
www.sfam.org.uk/pubs/microadvert.html

Your Society needs YOU!

SfAM is the voice for Applied Microbiology and often gets requests by journalists for background briefings or information. Are you interested in being part of a small group which will brief the media about applied microbiology? If so please contact **Nigel Poole** in Public Affairs at the Society Office. Phone 01344 750248 or email him at: **Sekona@btopenworld.com**

SfAM member appointed Chair

Congratulations to Martin Adams who has been appointed to a Chair in food microbiology at the University of Surrey.

SfAM member joins International Association for Food Protection

The International Association for Food Protection welcomed Dr Gary Acuff, member of SfAM for eighteen years, to the Executive Board as Secretary ahead of his term as president to begin in 2007. Dr. Acuff will take office at the conclusion of IAFP 2004 in Phoenix, Arizona.

Sponsor a new Member and win a £50 Book Token!

If you feel you could be our next winner for 2004, and would like some promotional material to help you recruit new members please contact Julie Wright, Membership Co-ordinator on 01234 326661 or email julie@sfam.org.uk.

Did you know you can now join the Society online?

To join the Society, or for more information about the benefits of joining the UK's oldest microbiological society, visit the following page on the Society website:
www.sfam.org.uk/join.html

School Associate Membership

Why not recommend SfAM membership to your local school?

Benefits

- Quarterly copies of *Microbiologist*
- Full access to the Society website
- Preferential rates at all Society Meetings
- All for **only £15.00** per annum!

Nigel Poole, our new Public Affairs Executive, reports on the Society's dialogue with the Department of Trade and Industry

SfAM – the Voice of Applied Microbiology in the outside world

In order to promote the interests of our members we need to listen to the views of key people in Government, Industry and Academia - where better to start than with Dr Monica Darnbrough, at the UK Department of Trade and Industry. Please let SfAM have your views on Monica's concerns about how to transform science into economic activity and the need for applied microbiology skills.

Dr Monica Darnbrough, CBE heads the BioScience Unit at the UK Department of Trade and Industry (DTI); the unit is the primary interface with specialist biotechnology companies as well as having a lot of contact — alongside the Department of Health — with pharmaceutical companies. The DTI's support for bioscience has covered a wide range of application areas; environmental cleanup; use of biotechnology in manufacturing processes (e.g. textiles); helping companies reduce their energy and water requirements; novel crops for food and non-food uses; development of novel diagnostics, medical devices and new drugs. Monica's initial training was as an animal physiologist and so she combines knowledge of biology with 20 years experience of the ways of Whitehall and of science policy.

We discussed with Dr Darnbrough the UK Government strategy for science and in particular the applied sciences.

"The Minister for Science and Innovation, Lord Sainsbury, and the Prime Minister himself, want the UK to be a preferred location for businesses which are based on bioscience. They are determined to put in place a regulatory regime which is based on sound science and which encourages innovation.

This approach seems to be working well for stem cell research – an area where Parliament considered the issue very carefully, building upon the Human Fertilisation and Embryology Act (1990) and taking into account the views of patients as well as researchers.

This kind of science-based, carefully considered, regulatory framework gives the UK a competitive edge as a location for research. Many other countries - as dispersed as Singapore, South Korea, Denmark and Sweden, many parts of the United States of America, Germany and Switzerland, are all striving to develop bioscience sectors. Companies choose to locate their research and development activities where they can find (or attract) the skilled personnel they need; where the regulatory and tax regimes encourage R&D; where there is a world class academic research community; and where there are supportive financial backers. The BioScience Unit in DTI works on all these factors, responding to companies' concerns and influencing all aspects of the business environment.

Over the last 10 years, the DTI has had programmes to help researchers to take their ideas from the laboratory into products and processes and services. Under the recent £25m Harnessing Genomics Programme the BioScience Unit supported a range of different initiatives. It has stimulated 6 Beacon projects to challenge researchers to make revolutionary interdisciplinary developments – in-silico models of organs; novel imaging methods; prediction of the effects of potential new drugs; novel devices to monitor gene activity from inside the body. In partnership with the Medical and the Biotechnology and Biological Sciences Research Councils (MRC and BBSRC), the DTI contributed to a £15m LINK programme in applied genomics under which 20 collaborative research projects between universities and large and small companies are being supported. One example in the analytical field involves GSK, Oxford Glycosciences, Oxford University and Micromass UK and another project, using extremophile micro-organisms, involves Chirotech Technology Ltd and Exeter University.

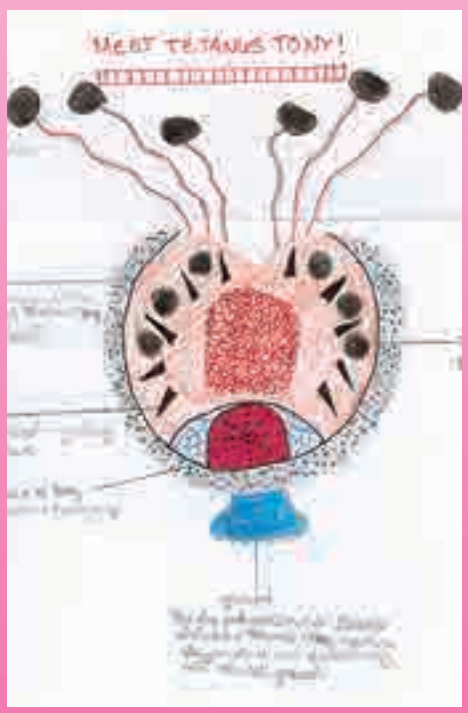
A recent report prepared by representatives of the biotech industry and the BioIndustry Association (the BioScience Innovation and Growth Team) has put forward a vision for bioscience in the UK in 2015. Some of the ideas have already been reflected in announcements in the last Budget to increase the budget for R&D in the NHS - £25m extra funding each year, reaching £1.2bn by 2008.

The Treasury's consultation to establish a 10 year investment strategy for science and innovation is one of many signs that the UK Government is keen to back science — and also that there is a determination to transform our excellent science into economic activity. As Government considers how to do this, it will also need to factor–in issues about skills shortages. The need for applied microbiology skills will be critical to a wide range of applications, from improving commercial fermentation to detection of toxins in food, water or air, and in devising novel analytical techniques and biosensors."

Design-a-bug

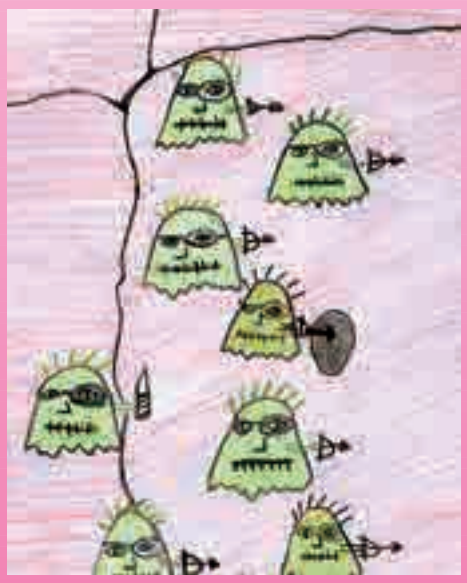
COMPETITION

You can see from the quality of the selection of entries here (there were over 180 in total) the difficulty the judges had in deciding the winners of the design-a-bug competition. Everyone who entered received a certificate, SfAM bug, pen and pencil-case. The winners in each category are shown receiving their superb drawing set and school entrants receiving their microscope. Presentations were made by SfAM committee members at special award ceremonies arranged at the winning school. Thank you and congratulations to everyone who took part.

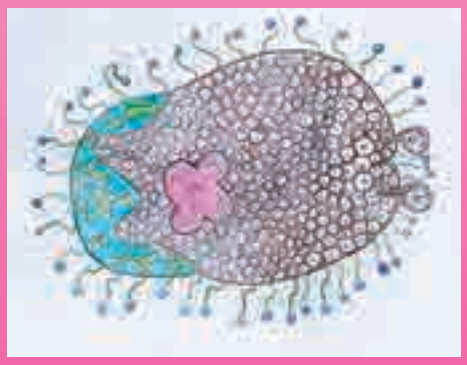


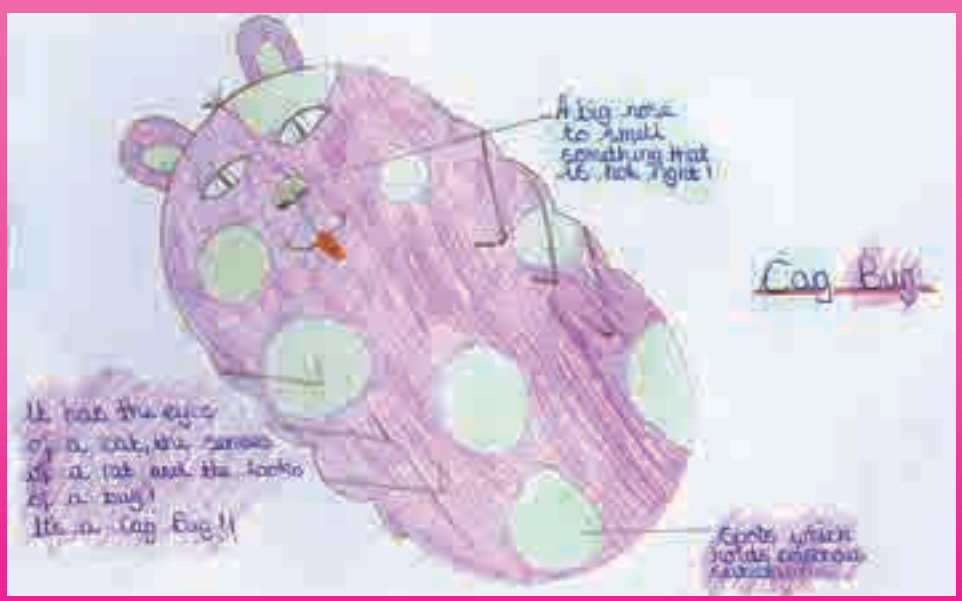
Aidan Bain of **Wallace Hall Academy** with his prize-winning entry of *Plookococcus spotei*

St Patrick's College was the only school in Ireland to gain a highly commended award in the competition. Fifteen boys in first form gained a highly commended award in the 9-12 age group. Ms Helen Rainey, their form teacher, was delighted with the award, saying that the boys worked hard on their designs but never expected to do so well. Each student was given a certificate and a prize by Dr Margaret Patterson, Honorary General Secretary of the Society. Dr Patterson is seen with the lucky winners.



Sheffield High School winner, Mashal Iftikhar





CPD ACCREDITATION

A total of **23 credits** have been awarded to this conference, broken down as follows:
Monday 12 July: **1 credit.**
Tuesday 13 July: **8 credits.**
Wednesday 14 July: **10 credits.**
Thursday 15 July: **4 credits**

Book Now!

If you want to be sure of your place at this important meeting turn to page 21 where you will find a booking form. Alternatively you can book via the website by downloading and completing a PDF booking form. **The closing date for registrations is Friday 11 June 2004 2004.** A £30.00 late booking fee will be applied to all bookings made after this date

DAIRY & FOOD MICROBIOLOGY

challenges and opportunities

sfam SUMMER CONFERENCE ● CORK, IRELAND 12-15 July 2004

This is the first time that the Society has visited the Republic of Ireland for its Summer Conference. It is fitting that the topic of dairy and food microbiology has been selected for this meeting since it is one of the main interests of our members, the agri-food industry is such an important one in the region and University College, Cork has an outstanding reputation for teaching and research in the relevant microbiology.

The programme addresses challenges in relation to animal and human disease but also opportunities presented by developments in food biotechnology, novel processes and products.

One session will be devoted to offered papers on any aspect of applied microbiology and posters will be available for viewing throughout the meeting.

Conference overview

This programme was up to date at the time of publication but may be subject to change. For the very latest information and an online booking form please visit: www.sfam.org.uk/sumconf.html

Monday 12 July 2004

14.00 onwards	Arrival of delegates
18.45 – 19.45	Dinner in Devere Hall, University College Cork (UCC)
20.00 – 21.00	Brains Trust in Students Union, UCC
21.00 onwards	Society Mixer in bar adjacent to Devere Hall, UCC

Tuesday 13 July 2004

07.30 – 08.30	Breakfast
09.00 – 10.45	**Session 1: Animal Health and Zoonoses**
10.45 – 11.15	Coffee and poster session
11.15 – 13.00	**Session 1 continued**
13.00 – 14.00	Lunch
14.00 – 15.45	**Session 2: Food Biotechnology**
15.45 – 16.15	Tea and poster session
16.15 – 17.25	**Session 2 continued**
18.30 – 19.30	**Trade Reception**
19.30	Depart for Old Middleton Distillery "Irish Night"
20.00	Dinner and Entertainment

Wednesday 14 July 2004

07.30 – 08.30	Breakfast
09.00 – 10.45	**Session 3: Human Health**
10.45 – 11.15	Coffee and poster session
11.15 – 12.25	**Session 3 continued**
12.25 – 13.30	Lunch
13.30 – 15.00	**Session 4: Offered papers (student)**
15.00 – 15.30	Tea and poster session
15.30 – 17.30	**Session 4: Offered papers (non student)**
17.30 - 18.00	W H Pierce Prize Winner
18.00 - 18.30	sfam Annual General Meeting
19.15	Coaches depart for UCC
19.30 – 20.00	Reception at UCC
20.00	Society Dinner at UCC

Thursday 15 July 2004

07.30 – 08.30	Breakfast
09.00 – 10.45	**Session 5: Novel Processes and Products**
10.45 – 11.15	Coffee and poster session
11.15 – 13.00	Session 5 continued
13.00	Lunch and close

Please note that ALL scientific sessions, breakfast, coffee, lunch and afternoon tea are located in Jury's Hotel and in Session 4, offered papers on ANY microbiology topic are welcome. You can now submit your abstracts via the Society website.

Book Now!

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For the latest information, costs and social events please visit us online at: **www.sfam.org.uk**

DAIRY & FOOD

Programme

Monday 12 July 2004

20.00–21.00 **Brains Trust**
Chair: Dr Pat Wall, University College, Dublin, Ireland
Panel: Prof Tim Cogan (Teagasc, Fermoy, Ireland); Prof Kevin Collins (UCC, Ireland); Prof David McConnell (Trinity College, Dublin, Ireland); Prof Fergus Shanahan (UCC, Ireland)

Tuesday 13 July 2004

Session 1. Animal Health and Zoonoses

Chair: Dr P Silley (SfAM Hon President)

09.00–09.35 **Treating mastitis in the cow – a tradition or an archaism?**
Dr E Hillerton, Institute for Animal Health, Compton, UK

09.35–10.10 **Assessment of cows for use of non-antimicrobial dry cow product**
Dr D O'Rourke, Pfizer, Kent, UK

10.10–10.45 **Tuberculosis - new light from an old window.**
Dr S Neill, Department of Agriculture & Rural Development and Queen's University, Belfast, UK

10.45–11.15 **Coffee and posters**

11.15–11.50 **Brucellosis - new aspects of an old disease**
Dr A McMillan, VLA, Surrey, UK

11.50–12.25 **Zoonotic potential of *Mycobacterium avium* subsp. *paratuberculosis*: the current position**
Dr I Grant, Queen's University, Belfast, UK

12.25–13.00 **The level of susceptibility to scrapie and BSE is a function of strain of agent, route of infection and the host protein PrP**
Dr W Goldmann, Institute for Animal Health, BBSRC, UK

13.00–14.00 **Lunch and posters**

Session 2. Food Biotechnology

Chair: Prof G Fitzgerald, UCC, Ireland

14.00–14.35 **Industrial manufacture of food enzymes**
Mr R Piggott, Kerry Bio-Science, Chicago USA

14.35–15.10 **Lessons from a Probiotic Genome**
Dr D van Sinderen, UCC, Ireland

15.10–15.45 **Microbial solutions to microbial problems; bacteriocins as tools for the control of undesirable flora**
Prof C Hill, UCC, Ireland

15.45–16.15 **Tea and posters**

16.15–16.50 **Food grade bacteria as cell factories for the production of food ingredients**
Dr E Smid, NIZO, Netherlands

16.50– 7.25 **Exploiting genetically modified microorganisms in the agricultural and food sectors**
Prof F O'Gara, UCC, Ireland

Wednesday 14 July 2004

Session 3. Human Health

Chair: Dr T Quigley, Safefood, UK

09.00–09.35 ***Campylobacter jejuni* – 'The Enigma File'**
Prof E Bolton, HPA, UK

MICROBIOLOGY challenges and opportunities

This programme was up to date at the time of publication but may be subject to change. For the very latest information and an online booking form please visit the Society website at www.sfam.org.uk/sumconf.html

09.35–10.10 **Salmonella: the interface between microbiology and epidemiology in outbreak investigations**
Dr E J Threfall, CPHL, LEP, Colindale, UK

10.10–10.45 **Verotoxigenic *E coli***
Prof J Mainil, Univ of Liège, Belgium

10.45–11.15 **Coffee and posters**

11.15–11.50 **The gastrointestinal phase of *Listeria monocytogenes* infection**
Dr C Gahan, UCC, Ireland

11.50–12.25 **Viruses in foodborne illness**
Dr M Carter, University of Surrey, UK

12.25–13.30 **Lunch**

Session 4. Offered papers

(student and non-student)
Chair: Mrs M Harrison
(SfAM Hon Meetings Secretary)

13.30–13.45 **Student paper 1**

13.45–14.00 **Student paper 2**

14.00–14.15 **Student paper 3**

14.15–14.30 **Student paper 4**

14.30–14.45 **Student paper 5**

14.45–15.00 **Student paper 6**

15.00–15.30 **Tea and posters**

Chair: Dr M Adams,
University of Surrey, UK

15.30–15.50 **Non-student paper 1**

15.50–16.10 **Non-student paper 2**

16.10–16.30 **Non-student paper 3**

16.30–16.50 **Non-student paper4**

16.50–17.10 **Non-student paper 5**

17.10–17.30 **Non-student paper 6**

Chair: Dr P Silley (SfAM Hon President)

17.30–18.00 **W H Pierce Prize Winner**

18.00–18.30 **SfAM Annual General Meeting**

Thursday 15 July 2004

Session 5. Novel Processes and Products

Chair: Dr P Silley (SfAM Hon President)

09.00–09.35 **Advances in thermal processing**
Mrs J Gaze, Campden & Chorleywood Food Research Association, Chipping Campden, UK

09.35–10.10 **Microbial inactivation by New technologies**
Dr P Mañas Universidad de Zaragoza, Zaragoza, Spain

10.10–10.45 **Microbiology of pressure treated foods**
Dr M F Patterson, Dept of Agriculture & Rural Development and Queen's University Belfast, UK

10.45–11.15 **Coffee and posters**

11.15–11.50 **From concept to consumer – the path to commercialising a probiotic**
Dr B Kiely, Dept Alimentary Health, UCC, Ireland

11.50–12.25 **Overcoming the technological hurdles in the development of probiotic foods**
Dr P Ross, Moorepark, Fermoy, Ireland

12.25 **Close of Conference and Lunch**

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Trade Show

Anyone wishing to exhibit at the trade show please contact Lynne Boshier at the Society Office.
Email: lynne@sfam.org.uk

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DAIRY & FOOD MICROBIOLOGY

challenges and opportunities

sfam SUMMER CONFERENCE ● CORK, IRELAND 12-15 July 2004

Venue

Jurys Hotel is unquestionably Cork's finest hotel, combining top class facilities and service with the warmth and friendliness for which Corkonians are renowned.

Located on the banks of the River Lee, the hotel is just a 5 minute walk from the city's bustling business, shopping and entertainment districts. The newly refurbished ground floor comprises the Glandore Restaurant with its wide menu selection, a lively atmosphere in Kavanagh's traditional Irish Pub and the Library Lounge, perfect for a relaxing drink.

BOOKING FORM and INVOICE

SFAM SUMMER CONFERENCE 2004 12 - 15 JULY 2004

Dairy & Food Microbiology: challenges and opportunities

Only ONE person per form please. If additional forms are required please photocopy this one
CLOSING DATE FOR REGISTRATIONS: Friday 11 June 2004. A LATE BOOKING FEE of £30.00 will be applied to all bookings made after this date.

FEES

	Full Members	Student, Honorary, Associate & Retired Members	Student Non - Members	Non - Members
Whole Conference Rate at Jury's Hotel: inclusive of registration fee, coffee breaks, lunches, dinners, including Society dinner, Distillery Visit and accommodation for the entire conference	£400.00	£200.00	£400.00	£595.00
Whole Conference Rate at Lancaster Lodge or Jury's Inn: inc. of registration fee, coffee breaks, lunches, dinners, including Society dinner, Distillery Visit and accommodation for the entire conference	£200.00	£100.00	£300.00	£495.00
Day Rate: 08.30 - 17.00 hours per day, or part thereof, inc. of registration fee, coffee lunch and tea	£100.00	£50.00	£100.00	£150.00
Overnight accommodation: en-suite room per night inclusive of breakfast	**Monday, Tuesday or Wednesday night. (All membership classes pay the same rates) £100.00 per night** (Jury's Hotel) OR **£67.00 per night** (Lancaster Lodge or Jury's Inn)			

YOUR COSTS

Charges - please tick the applicable box(es)				Amount
☐ **Whole Conference Rate at Jury's Hotel:**				£
☐ **Whole Conference Rate at Lancaster Lodge or Jury's Inn:**				£
☐ **Day Rate** (please tick the DAY(S) you wish to attend):	**Tues 13th:** ☐	**Weds 14th:** ☐	**Thurs 15th:** ☐	£
☐ **Overnight accommodation:** (please tick the NIGHT(S) you wish to stay and tick the LOCATION: Please note that space in Jury's Hotel is limited. Late applicants will be lodged at Jury's Inn or Lancaster Lodge	**Mon 12th:** ☐	**Tues 13th:** ☐	**Weds 14th:** ☐	£
	Jury's Hotel: ☐	**Jury's Inn:** ☐	**Lancaster Lodge:** ☐	
☐ **I wish to attend the Society Dinner on Wednesday evening (This is included in the Whole Conference Rate but costs £50.00 for delegates who elect to pay the Day rate).** Please note that numbers are limited:				£
☐ **I wish to attend the Distillery Visit on Tuesday evening (This is included in the Whole Conference Rate but costs £58.00 for delegates who elect to pay the Day rate).** Please note that numbers are limited:				£
☐ **I wish to attend the Brains Trust Buffet and Social Evening on Monday evening (This is included in the Whole Conference Rate but costs £20.00 for delegates who elect to pay the Day rate):**				£
☐ **LATE BOOKING FEE** Payable for all bookings made after Friday 11 June 2004:				£30.00
			TOTAL AMOUNT REMITTED:	£

YOUR DETAILS

Title: _____ **Family Name:** _____ **First Name:** _____

Address: _____

_____

Tel No: _____ **Fax No:** _____ **Email:** _____

Please indicate any special dietary or other requirements (such as disabled access): _____

_____

YOUR PAYMENT

● **For all participants: The Society DOES NOT INVOICE for conference fees. Please treat your completed booking form as an invoice. Cheques must be in £ STERLING ONLY and made payable to 'The Society for Applied Microbiology'. Foreign cheques/ drafts MUST be negotiable for the full amount due. Please note that AMERICAN EXPRESS and DINERS CARDS are NOT ACCEPTED.** However the following credit and debit cards are acceptable: VISA, Mastercard, Eurocard, Delta, Electron, JCB, Maestro and Solo.

☐ **Cheque enclosed** ☐ **Please charge my *Mastercard/Visa card /Debit card*** *(please delete inapplicable items)*

TOTAL Amount enclosed/ to be debited: (*Remember to include your LATE BOOKING FEE if your are booking after 11 June 2004) **£** _____

Card number: ☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐ Expiry Date: ☐☐☐☐ Issue No. ☐☐☐ *(Debit cards only)*

Signature: _____ *Date: _____ Cardholder's address to which credit card statement is sent:

_____

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Please return the completed form by fax (post if you are enclosing a cheque) to: **The Society for Applied Microbiology, The Blore Tower, The Harpur Centre, Bedford MK40 1TQ, UK. Tel: 01234 326661. Fax: 01234 326678. Email: meetings@sfam.org.uk**

SUGGESTION: please photocopy this form to save mutilating your copy of the Microbiologist!

STUDENTSHIP Application

Only ONE form per student please. If additional forms are required please photocopy this one

SFAM SUMMER CONFERENCE 2004 12 - 15 JULY 2004

☐ **I wish to apply for a SfAM Studentship grant to attend the 2004 SfAM Summer Conference**

About this award

The Society offers Studentships to enable **student members** to attend Society meetings. These grants cover registration, accommodation, meals (where appropriate) and modest travel expenses. Preference is given to students offering a paper or poster and who have not previously received this award. To be considered for a Studentship grant, please complete this form in **BLOCK CAPITALS** and return it to the Society Office **no later than 6 weeks before the date of the meeting you wish to attend.**

Your details

Title:_____ **Family Name:**_____ **First Name:**_____

Address:_____

_____ **Postcode:**_____

Tel No:_____ **Fax No:**_____ **Email:**_____

University or College:_____

Your Department:_____ **Position in Department:**_____

Grant authority:_____

Your intended career:_____

Your costs

Expected Travel Costs:_____

Other costs - please specify:_____

_____

_____

Why do you wish to attend this meeting?

Please give your reasons:_____

_____

_____

Your signature:_____ **Date:**_____

(If you need more space for your answer please continue on a separate sheet)

Will you be contributing to the meeting by offering a Poster or presenting a paper? ☐ **Offering a Poster** ☐ **Presenting a Paper**

Your Supervisor's support

This section **MUST** be completed by your Supervisior or Tutor. Applications which are not supported by your Supervisor will be automatically rejected. **Please give your reasons why the applicant should receive a studentship:**

_____

_____

_____

Supervisor's name:_____ **Tel and extension:**_____

Supervisor's signature:_____ **Position:**_____ **Date:**_____

(If you need more space for your answer please continue on a separate sheet)

In signing this application I agree to reimburse the Society for any costs it may incur in awarding this grant should the applicant fail to attend the conference or fail to notify the Society of their inability to attend the conference within 14 days of the start of the meeting.

Please confirm your agreement by ticking the appropriate box: ☐ **I agree** ☐ **I do not agree**

Please return your completed application by fax or post to: **The Society for Applied Microbiology,**
The Blore Tower, The Harpur Centre, Bedford MK40 1TQ, UK. Tel: 01234 326661. Fax: 01234 326678. Email: meetings@sfam.org.uk

SUGGESTION: please photocopy this form to save mutilating your copy of the Microbiologist!

Cell & Molecular Biosciences

Epithelial-Bacterial Pathogen Interactions

School of Cell and Molecular Biosciences, University of Newcastle, UK

July 22 - 23 2004

This highly focused meeting will consist of two related symposia, discussing the interactions of human pathogens with respiratory and intestinal epithelia. The aim will be to highlight recent developments in our understanding of how bacteria interact and modulate the physiological function of these epithelial barriers, at the molecular, cellular and whole tissue level.

Further information about this meeting can be found at:
http://www.ncl.ac.uk/camb/research/EBPI/index.htm

EFFoST

FOOD INNOVATIONS FOR AN EXPANDING EUROPE

26 - 29 October 2004 ● Westin Hotel, Warsaw, Poland

This conference is organised by **EFFoST** in association with the **Warsaw Agricultural University** and will be administered and sponsored by **Elsevier.** The conference seeks to share and integrate advances regarding innovative aspects of dehydration, preservation and packaging and to disseminate current food chain management issues.
The conference aims to bring together the most recent innovations for the growing and extending European food chain. Plenary lectures by leading European scientists will be supplemented by contributed oral and poster presentations for which abstracts are currently invited.

Sessions include:
- Innovative Dehydration
- Innovative Preservation
- Innovative Packaging
- The Expanding European Food Chain

The language of the conference will be English.
The deadline for abstracts is 2nd July 2004.

information

For more details please contact:
Claire Norris
EFFoST Conference Secretariat
51 Kestrel Way, Wokingham, Berkshire RG41 3HA UK
Tel: +44(0) 118 377 4696
Fax: +44(0)118 977 6680
E-mail: effost-conference@elsevier.com
Website: http://www.effost-conference.elsevier.com/

Education in Ethiopia

In the fourth in a series of articles, **Dr Jenny Search** reports on her continuing two-year voluntary service overseas placement at Debub University in Ethiopia

I AM EMPLOYED by Debub University as a biology instructor, but as a VSO (Voluntary Service Overseas) volunteer we are encouraged to become involved in other issues such as HIV/AIDS awareness and gender issues. As a member of the fairer sex myself I decided to try and find out about the issues facing females in Ethiopia.

From the start, life is harder for girls. Boys are given preferential feeding from an early age. Females in a family are expected to do all the cooking and cleaning, as well as chores such as gathering firewood and collecting water. The male members of the family get to sit around and drink coffee served to them by girls. If the girls in a family are lucky enough to be allowed to go to school then they are likely to perform less well than the boys as they have less time to study outside of school. Yet according to VSO, the education of girls is one of the most effective means of reducing poverty and empowering women. Things are very slowly beginning to change as the government is making an effort to encourage more female students into schools and universities. This effort is supported by the International Development Goals launched by the UN five years ago. These goals include access to basic education for all by 2015 and to have equal numbers of males and females in schools by 2005. Although I recently read the British government doubts the latter target will be reached on time (1).

Data from the period 1992-1997 show that in Ethiopia, the female share of tertiary education enrolment is about 20% but in 1999 only 14% of the graduates were women (2). The same study also showed that only 6% of teachers in tertiary education were female (compared to 10% in secondary education). It is difficult to get reliable statistics, but from my experience in Debub University, women are hugely underrepresented. In the faculty of Natural Sciences there are no Ethiopian female lecturers and only 4 female expatriate lecturers consisting of three ladies from India and myself. As for the students, the percentage of girls is; in biology 31%, statistics 19%, chemistry 12%, maths 6% and in physics 0%! The Ethiopian government is using positive discrimination as one way of increasing University admissions of female students. Female students are allowed to enter with lower grades from school, however once on campus they do not have the support required to pass the

Far left: *'Women's' assertiveness training workshop'. All the freshman female students attended*

Below: *Women at the market in a small village in Southern Ethiopia.*

Top right: *Woman collecting water from a communal standpipe*

Bottom right: *A small girl chewing sugar cane while carrying her load*

Picture by kind courtesy of Keith Holmes

Picture by kind courtesy of Keith Holmes

Picture by kind courtesy of Mark Biver

courses and often drop out at the end of the first year. Data from the women's' affairs office for the Academic Year 2001/2002 show that the attrition rate for all female students in the University was 42%. Unfortunately the highest attrition rate was in the sciences. 70% of female students enrolled into the Faculty of Natural Sciences dropped out after the first semester.

In Debub University the womens' affairs office was established to try and tackle some of the issues faced by the female students. At the beginning of the academic year the new female students were given a "buddy" — a girl from the year above who showed them around, took them to the dining hall etc. There was also a training day organised where the new female students were given advice about being assertive without being aggressive. Students from the year above shared some of their experiences in the form of stories and poems. Various other strategies are being implemented, including giving the girls their own study space — the library is overcrowded and there is no male chivalry when it comes to finding seats! Tutorials are also given to female students in subjects in which they tend to perform poorly, such as maths. So a start is being made, but if I think of the number of females in high-ranking positions in British universities, Ethiopia is not the only country with some work to do.

Last year I wrote a small proposal with a colleague which was accepted by the university to test the bacteriological quality of the drinking water in Awassa. The money was made available to us to buy the chemicals we need (mostly different kinds of media) but the actual purchasing process is far from simple. The standard procedure is to put out a tender where at least three different companies have to supply quotes for all the chemicals/equipment needed and then the best offer is taken up. However this process usually takes at least a year with all the paperwork involved. To try and speed things up the university allowed us to use a cash system where we could buy the chemicals directly from the suppliers via a purchasing committee. This is where we faced problems. Number one, there are very few suppliers in Ethiopia and they do not carry much stock and usually only order large quantities of specific items. Secondly the purchasing committee have to make a special trip to Addis Ababa and are not necessarily familiar with the chemicals ordered. This means if the exact chemical specified on the order is not available then they cannot substitute it for an alternative chemical/media which could still be used.

After two trips where the committee came back empty handed I started to lose hope that the project would even be started before I'm due to leave. I ended up going to Addis Ababa myself (a 6 hour bus journey which is not much fun) and traipsing around as many suppliers as I could find.

I found one place with 3 jars of eosin methylene blue (EMB) agar (in the back of a cupboard) and other suppliers assured me they could order small quantities of nutrient and other agars in as little as 6-8 weeks.

The University has purchased the EMB agar we now just have to acquire it from the store. I won't be holding my breath but hopefully this means we can make a start in the near future!

Jenny Search
Debub University, Ethiopia

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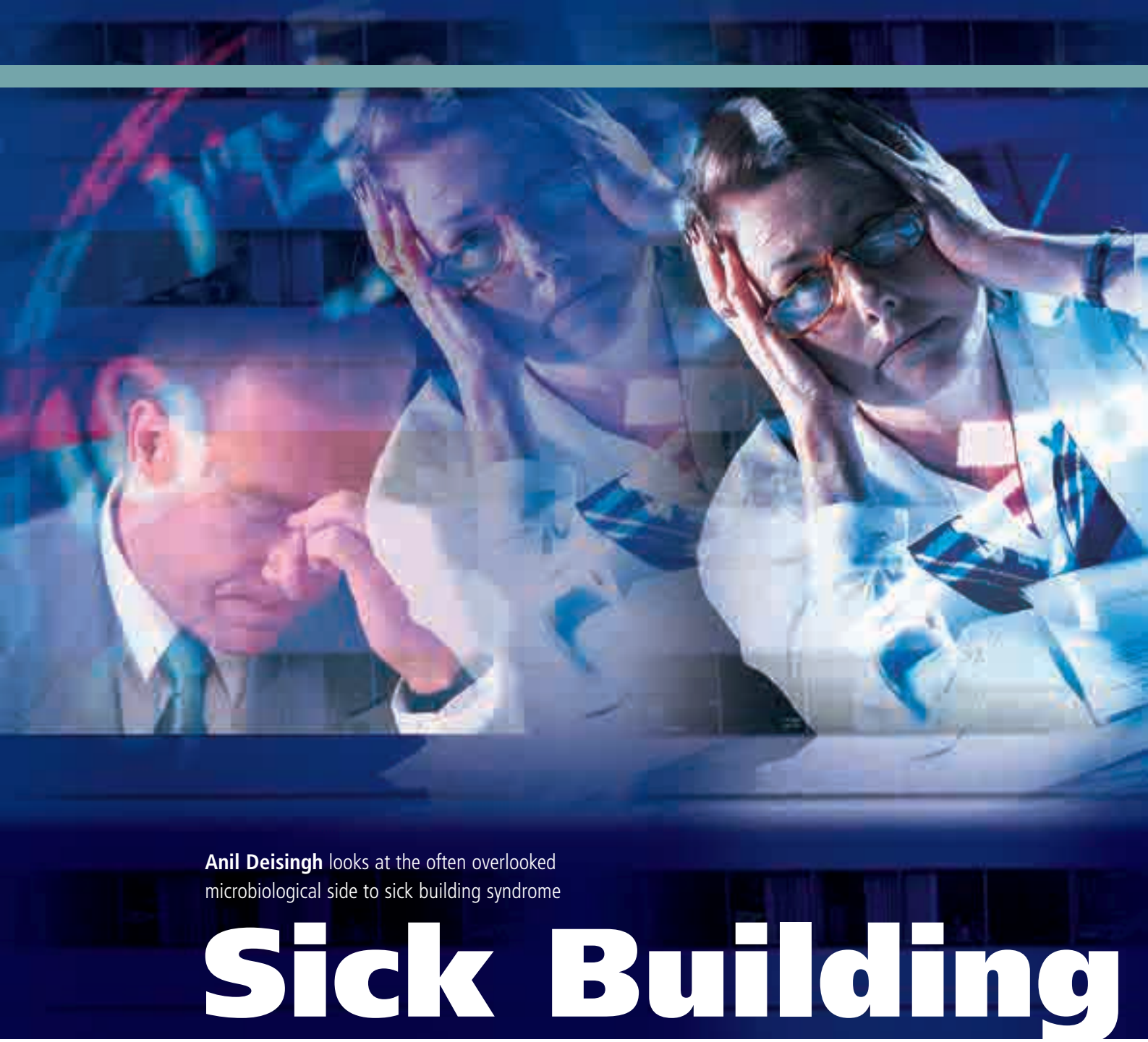
Further Information

- www.neal-jenny.info
- www.vso.org.uk.
- The Faculty of Natural Sciences at Debub University: http://home.no/dufns



Anil Deisingh looks at the often overlooked microbiological side to sick building syndrome

Sick Building

MODERN ADVANCES in engineering technology have allowed buildings to be sealed tightly with the air being allowed to re-circulate within them while indoor air contaminants build up. Employee complaints result from cigarette smoke, odours, low-level contaminants, poor air circulation, thermal gradients, humidity, job pressures, lighting, workstation design or noise (OSHA, 2002). Indoor air quality (IAQ) investigations often fail to identify any harmful levels of toxic substances. According to OSHA (2002), complaints are often of a subjective, non-specific nature and are associated with periods of occupancy. Symptoms include headache, dizziness, nausea, tiredness, lack of concentration and irritation of the eyes, nose and throat. The symptoms tend to disappear when the building is exited. The primary sources of IAQ problems were identified by a survey carried out by the National Institute for Occupational Safety and Health (NIOSH, 1989) and these are summarised in Table 1. Employee complaints can be due to two types of building problems: sick building syndrome (SBS) and building-related illnesses (BRI). The former is used to describe situations in which the occupants of a building experience acute health effects linked to being in a building but no specific illness can be identified. Most of the affected people indicate relief soon after leaving the building. The latter term is used when symptoms of illness that can be diagnosed are identified and may be attributed directly to airborne building contaminants (EPA, 1991). Indicators of BRI include symptoms such as cough, chest tightness, fever, chills and muscle aches. The affected workers may require prolonged recovery times after leaving the building.

Several factors have been listed as contributing to sick building syndrome. These include (EPA, 1991):

- Inadequate ventilation.
- Chemical contaminants from indoor sources e.g., adhesives, carpeting and pesticides.
- Chemical contaminants from outdoor sources e.g., motor vehicle exhausts and plumbing vents.
- Biological contaminants such as bacteria, moulds, pollen and viruses.

In this article, we will concentrate on biological contaminants and their impact upon indoor air quality.

Syndrome

Biological Contaminants

Microorganisms (Figure 1), mainly fungi and bacteria, are important factors that influence indoor air quality. Many bacterial and fungal species are isolated from indoor air with the species found dependent on nutrient source, water availability and temperature (Institute for Environment and Health, 2000). Temperature and relative humidity are major factors influencing the levels of fungi and bacteria in indoor situations.

Several health effects have been associated with fungal and bacterial species in the indoor environment. These include rhinitis, upper respiratory symptoms, asthma, allergic skin reactions, tiredness and headache. There is much evidence of a relationship between damp and mouldy housing and reports of respiratory symptoms in children.

Sources of micro-organisms in indoor air include air handling system condensate, cooling towers, water-damaged materials, high humidity in indoor areas, damp organic material and porous wet surfaces, humidifiers, hot water systems, outdoor excavations, plants, animal faeces, insects and food and food products (OSHA, 2002). In addition, *Legionella pneumophila* may be found in hot water tanks, washing systems and pools of stagnant water but health effects only appear when the contaminants are aerosolised within the indoor region.

In this article, we will concentrate on the effects of bacteria and moulds as these tend to be implicated in major health concerns more readily than other microbes.

Bacteria

The most common bacteria found in indoor environments include *Bacillus*, *Pseudomonas*, *Staphylococcus*, *Micrococcus*, *Methylobacterium and Flavobacterium*. It is of interest to note that some bacteria which cause infections are part of the normal microflora of indoor air and, if they are present, this should not be a particular cause of concern (Haury, 1998). Other species of importance include the Actinomycetes and the *Legionella* species.

The primary source of bacteria, in most interior situations, is the human body. About seven million skin scales are shed every

minute per person with each fragment containing an average of four viable bacteria. The main factor in dispersing these bacteria is abrasion, although showering increases the loss rate for bacteria. It has been claimed that *Staphylococcus aureus* is shed more abundantly by men than women, but other organisms are not sex-dependent (Solomon and Burge, 1984). Bacteria are released from the human respiratory tract, especially during coughing and sneezing. *Streptococcus pneumoniae* and *Mycobacterium* species are readily transferred through droplets expelled from the respiratory tracts of infected people.

Bacillus is a genus of Gram-positive organisms which are ubiquitous in nature (soil, water and airborne dust). Most species of *Bacillus* are harmless saprophytes but two species (*B. anthracis*, the cause of anthrax and *B. cereus*) are medically significant. Anthrax infection can occur in three ways: cutaneous (skin), inhalation and gastrointestinal. The spores of *B. anthracis* can live in the soil for many years with humans becoming infected by handling products from infected animals or by inhaling the spores from contaminated animal products (Centres for Disease Control, 2003). *B. cereus* has a wide distribution in soil, dust and air and it has been implicated in wound infection, meningitis and diarrhoeal food poisoning.

Air-conditioning units are sources of bacterial aerosols with *Pseudomonas* and *Acinetobacter* being common. More than 140 species of the former have been described with most of these being saprophytic. The Pseudomonads are Gram-negative rods and they may be responsible for urinary tract infections, pneumonia and eye and ear infections. They are found in the soil, water or on plants. Similarly, bacteria of the genus *Acinetobacter* are Gram-negative and widespread in water, soil and living organisms. Some strains of *Acinetobacter* can cause disease especially in very ill and/or hospitalised patients.

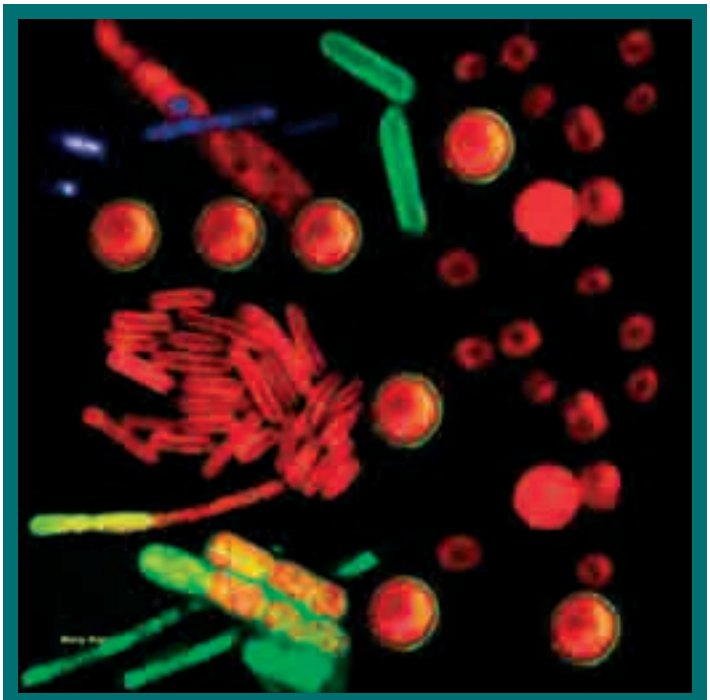


Figure 1: *A range of micro-organisms highlighted by fluorescence. (Reprinted by permission of Dr. Conrad Mullineaux, University College London).*

High-levels of Gram-positive organisms such as *Micrococcus* and *Staphylococcus* indicate over-crowding and inadequate ventilation.

The Actinomycetes (*Actinomyces*, *Nocardia* and *Streptomyces*) family of bacteria are primarily found in soil and are widely distributed; they are vital in the mineralization of organic matter. However, a few are pathogens and may cause skin and mouth lesions. *A. viscosus* and *A. naeslundii* have been isolated in large numbers on teeth that have decayed to a large extent. These species are early colonizers of teeth surfaces in the formation of plaque. The medically important aerobic actinomycetes can cause mortality especially in immunocompromised patients.

Legionnaire's disease is a pneumonia-like condition caused by *Legionella pneumophila*. The incubation period of the disease ranges from 2 to 10 days and symptoms include tiredness, weakness, fever, cough, diarrhoea and chest pain. The disease is transmitted via drinking water (legionella.org, 2002). The bacteria are natural inhabitants of water and can be detected in rivers, lakes and streams. It was long believed that the organism is aerosolised in water and people inhale the droplets containing *Legionella*. New evidence suggests that aspiration is the most common way for the bacteria to enter the lungs. This is the process whereby a choking mechanism causes the secretions in the mouth to enter the lungs rather than the stomach (legionella.org, 2002). Aspiration occurs most readily in patients who smoke or have lung disease.

The major source of Legionnaire's disease is the water distribution systems of large buildings such as hotels and hospitals. Other sources include cooling towers, mist machines, humidifiers, whirlpool spas and hot springs. It is now being claimed that air-conditioning systems, once thought to be implicated in disease transmission, are not a source (legionella.org, 2002).

TABLE 1 Primary sources of IAQ problems

Inadequate ventilation	53%
Contamination from inside a building	16%
Contamination from outside a building	10%
Microbial contamination	5%
Contamination from building fabric	4%
Unknown sources	13%

Moulds

Moulds are widespread in nature and they assist in breaking down organic matter. It has been estimated that there are more than 100 000 species of moulds with some of the most common being *Cladosporium*, *Penicillium* and *Aspergillus* (Figure 2). Moulds are more likely to grow in water or in damp conditions.

In general, most moulds are not health hazards but for individuals who have allergies or compromised immune systems there may be symptoms such as fevers and breathing difficulties. Other symptoms of mould infestation include eye irritation, cough and runny nose. Levels of indoor fungi are higher in

summer than in the winter months indicating the influence of outdoor sources (Solomon and Burge, 1984). Central air-conditioning reduces indoor spore levels by about 50% once the doors and windows remain closed. Window air-conditioning reduces indoor spore concentrations to 5% of those in normally ventilated rooms while rooms with open windows average about 60% of those outdoors (Solomon and Burge, 1984). A major factor in decreasing spore levels is the resultant decreased humidity of air-conditioning systems.

Certain fungi will produce mycotoxins which are very toxic. The *Aspergillus* species are the main producers of these compounds which include aflatoxin, ochratoxin and sterigmatocystin. Species of *Aspergillus* known to produce mycotoxins include *A. flavus*, *A. parasiticus*, *A. versicolor* and *A. ochraceus* (Haury, 1998).

Aspergillus fumigatus is a widespread fungus and can be present even in small quantities of organic material. In the presence of compost, the number present can exceed 1 million / m^3 while in relatively clean indoors, the levels are generally low (1-200 / m^3). In regions where organic materials are stored, concentrations may exceed 20 x 10^{10} / m^3 (Solomon and Burge, 1984). Various reports have indicated that symptoms of aspergillosis can include any of coughing, shortness of breath, bronchitis and pneumonitis. Houseplants have been suspected as sources of increased *A. fumigatus* levels in homes and hospitals and pets have also been implicated although no direct evidence exists. Other factors leading to increased levels of indoor moulds include poor landscaping practices including the accumulation of organic debris and high shade levels and the use of appliances such as evaporative humidifiers and air-conditioners (Solomon and Burge, 1984).

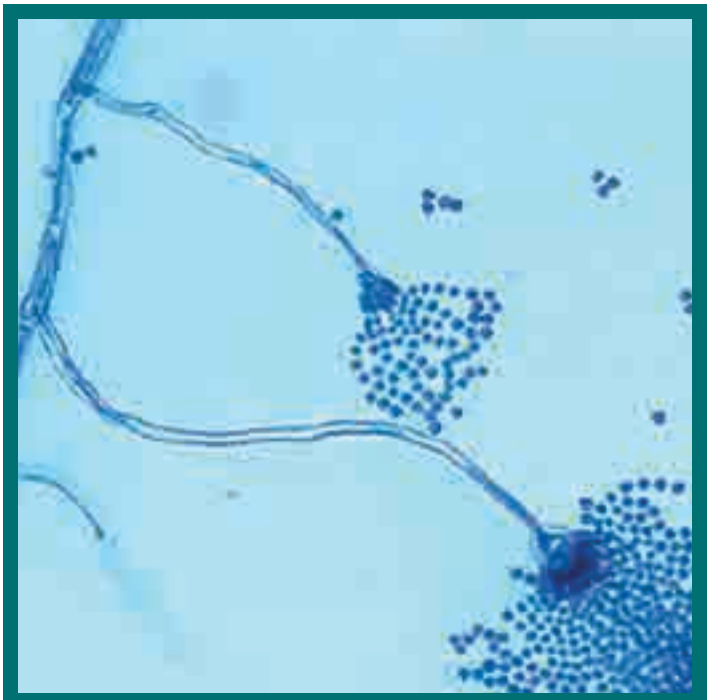


Figure 2: *Aspergillus. (Reprinted by permission of Dr. Joanne Weber, Department of Medical Microbiology and Immunology, University of Wisconsin-Madison).*

Cladosporium species are probably the most common fungi recovered both outdoors and in indoor situations during summer in the USA, Europe and Asia. However, they are always more abundant outdoors. *Penicillium* will be present in larger concentrations in winter months and are more abundant indoors than outdoors. Surprisingly, it has been reported that levels of *Penicillium* increase with house cleaning and repair (Solomon and Burge, 1984).

Contamination of domestic interiors usually involve outdoor fungi which can easily grow indoors especially when water and/or moisture levels increase. Moulds can grow on any organic material which is wet. For example, damp walls will have increased growth of *Cladosporium cladosporoides* and *Aureobasidium* while damp leather, cotton and paper will become rapidly covered with *Penicillium* or *Aspergillus* species (Solomon and Burge, 1984). Other indoor materials which can easily support mould growth include carpets, furniture stuffing (e.g. feathers), fire-proofing materials and stored organic material.

TABLE 2 Guidelines for spore and pathogen levels in indoor air (ref.1)

Organism	Limit (cfu/m^3)
Fungi	100 - 1000
Actinomycetes	0 - 100
Bacteria	0 - 500
Pathogenic Bacteria	0
Viruses	0
Total Microbes	**Up to 750**

One mould of interest, although it is not present as commonly as *Aspergillus*, *Penicillium* or *Alternaria*, is *Stachybotrys chartarum* (*S. atra*). It is a greenish-black mould which can grow on material with a high cellulose and low nitrogen content such as fibreboard, paper, dust and lint. Growth occurs when there is water damage, high humidity, water leaks or flooding (Centers for Disease Control, 2002). There have been suggestions that *S. chartarum* can cause acute idiopathic pulmonary damage in infants but this has not been proven so far.

Other Factors Affecting IAQ

Although we have concentrated on bacteria and moulds, several other parameters are involved when determining indoor air quality and the presence of sick building syndrome. These include (OSHA, 2002):

(a) Pollen grains can enter buildings through windows, doors and even cracks in the walls. Air-conditioning systems can considerably reduce the levels of pollen in indoor air.

(b) Carbon monoxide which may arise from tobacco smoke and engine exhausts and can lead to dizziness, nausea, cardiovascular problems and death.

(c) Oxides of nitrogen which are derived from gas furnaces and appliances, tobacco smoke and engine exhausts. These cause eye, respiratory and mucous membrane irritation.

(d) Volatile organic compounds (VOC's) such as benzene, toluene, alcohols, pesticides and polycyclic

aromatic hydrocarbons. Sources include paints, glues, insecticides, tobacco smoke, cosmetics and photocopiers. Acute health effects are nausea, dizziness, eye and respiratory tract irritation and headache.

(e) Miscellaneous inorganic gases including ammonia, sulphur dioxide and hydrogen sulphide which arise from acid drain cleaners and combustion products. These may cause effects similar to those listed in d) above.

(f) Tobacco smoke which can result in eye and nasal irritation, coughing, wheezing, sneezing, headache and sinus problems. Tobacco smoke is a major contributor to IAQ problems as it contains hundreds of toxic substances, including those described above.

Threshold Limit Values for Microorganisms

At present, no comprehensive standards exist for acceptable levels of indoor air contamination with respect to micro-organisms. This is due to the extremely large numbers of both bacteria and moulds present and generating standards for each species is impossible. However, a few guidelines exist and these are summarized in Table 2.

Both the American Conference of Government and Industrial Hygienists (ACGIH) and the American Industrial Hygiene Association (AIHA) indicate that the upper limit for airborne fungi should be 1000 cfu/m^3 (arche.psu.edu, 2002).

It should be noted that even these guidelines are not widely accepted and it may be better to use the indoor: outdoor ratio of micro-organisms at a particular site. Values much greater than one may indicate that there are problems with the indoor air quality.

Building Investigation Procedures and Solutions to Sick Building Syndrome

According to the USEPA (1991), *"the goal of a building investigation is to identify and solve indoor air quality complaints in a way that prevents them from recurring and which avoids the creation of other problems. To achieve this goal, it is necessary for the investigator to discover whether a complaint is actually related to indoor air quality, identify the cause of the complaint, and determine the most appropriate corrective actions."*

The investigation procedure begins with a walkthrough inspection of the contaminated area in order to obtain information about the four factors which can influence IAQ. These are:

(a) the occupants; (b) the heating, ventilation and air-conditioning (HVAC) system; (c) possible pollutant pathways; and (d) possible contaminant sources.

Once it has been decided that there is a possible case of sick building syndrome, solutions may include one or more of the following (US EPA, 1991):

- Pollutant source removal or modification which is effective once the sources are known
- Increasing ventilation rates and air distribution
- Air cleaning, in addition to source control and ventilation, but this may not be effective as the first two approaches.
- Education and communication which are effective in both remedial and preventative indoor air quality management programmes.

Conclusion

In this brief survey, the issue of sick building syndrome has been considered from a microbiological viewpoint as this is sometimes overlooked, especially in developing countries, in favour of chemical contaminants. Usually, problems arise when a building is operated in a manner which is inconsistent with its original design and/or prescribed operating procedures and, on a few occasions, problems result due to poor building design or occupant activities (USEPA, 1991).

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Dr Anil Deisingh
currently works in Trinidad and Tobago and may be contacted at: anildeisingh@aol.com

Candidiasis and cryptococcosis of humans

Steve Smith explores the world of pathogenic fungi

A number of fungal species have the capacity to exploit human beings, either giving rise to merely uncomfortable circumstances or life threatening conditions of disseminated infection. Foremost amongst such fungi are the yeasts *Candida* and *Cryptococcus*. The former are more common, while the latter appear to have all the attributes required to colonise and exploit if not destroy the human race, yet their occurrence remains relatively infrequent.

The overall incidence of fungal infections has increased dramatically over the last 20 years according to recent survey data. Infections due to *Candida* species account for approximately 80% of all major systemic fungal infections and are the most common fungal infections of the immunocompromised. Furthermore *Candida* species are the second most common cause of urinary tract infections and the fourth most common cause of nosocomial blood stream infections, which in turn are associated with considerable mortality.

Potentially pathogenic *Candida* species exist on a worldwide basis (Table 1) of which *Candida albicans* is the most common. However incidence of the non -*Candida albicans* species (NACs), such as *Candida tropicalis* and *Candida glaberata*, appears to be on the increase. Although frequently present as part of an individuals natural or commensal microbial flora, they should also be considered as opportunistic and highly dangerous pathogens.

Studies have attempted to relate the different *Candida* species of Table 1 to a range of underlying diseases or medical practices, however, while failing to make appropriate connections, such studies have underscored the great variety of circumstances or patient states which *Candida* can exploit.

Medical procedures and associated practice continue to encourage *Candida* infection or candidiasis (Table 2), however, underlying disease is a major if not the major predisposing factor in candidiasis. The advent of human immunodeficiency (HIV) gave rise to heightened interest in fungal infections, hence greater focus on the

development of more efficacious patient care and support. Individuals from the developed world with acquired immunodifficiency syndrome (AIDS) so frequently present with candidiasis that the presence of *Candida* in forms like oral and oesophageal thrush (Fig. 1) became part of the diagnostic criteria of the AIDS syndrome. In such circumstances *Candida* can occur on its own or with other infectious entities for example Herpes Simplex Virus (HSV) in a form of "symbiotic" relationship exploiting the ulcers produced by HSV.

All *Candida* species have similar morphology and physiology. In common with insects and arthropods chitin/n-acetyl glucosamine is a major structural component, incorporated into cell walls in association with considerable quantities of mannose and mannose moieties (Fig. 2). Surface exposure of such mannose moieties has marked consequences in the interaction of pathogen and human host as mannose and mannoproteins have a variety of roles including adhesion to living and inanimate surfaces, cellular recognition by both innate and adaptive vertebrate immunity and the modulation of adaptive immune responses by *Candida*. Fig. 2 also clearly demonstrates the dimorphic nature of *Candida* species, which are capable of both filamentous (hyphal/psuedohyphal) and unicellular (blastospore) forms of growth. Such an ability, which may be included in a list of *Candida* virulence factors (Table 3), remains something of a mystery. Many reports and investigations have attempted to elucidate the factors, which control or influence *Candida* growth forms, resulting in authorities citing temperature, pH shifts and partial gas pressures amongst others. In common with such contradictory findings only speculation exists as to the perceived value of a dimorphic growth habit. A hyphal form mediates greater anchorage, a consequence of greater surface area contact, in turn enhancing penetration of host structural entities, particularly when assisted by localised hyphal-tip growth and lytic enzyme release. Contrastingly as single or budding cells *Candida* is readily dispersed by circulation of body fluids ensuring effective host exploitation thereby giving rise to disseminated or systemic infection. However, authorities recognise that *Candida* in unicellular form can compromise and penetrate host structural entities, furthermore experimental evaluation and control of dimorphism remains problematical obscuring our understanding of any merits associated with a dimorphic growth habit.

Peripheral parts of the human body are readily colonised by *Candida* (Fig.1) and although uncomfortable for the individual are generally not life threatening. Systemic or disseminated *Candida* may develop from such sources, however in the absence of tissue trauma (Fig. 3), a main route of *Candida* entry is the gastro-intestinal (GI) tract. Initial events in establishment and subsequent penetration of the GI tract are for the fungus fraught. Regular passage of food solids, mucus movement and the sloughing of epithelial cells make for a most unstable site, potential precluding adhesion and adherence.

The early sequence of events in establishment and penetration of the GI tract by *Candida* in a unicellular form include, contact with the mucus blanket, penetration of the mucus blanket, establishment and attachment to underlying epithelial cells. As *Candida* cells are immobile, contact with overlying mucus comes through natural churning of gut contents. Penetration of overlying mucus may occur through pores present in the gel matrix, hydrolytic enzyme action or a combination of both. Attachment to epithelial cells is best summarised as a two stage process mediated by complex physico-chemical and biological forces. Initially a loose or reversible adhesion occurs, mediated by van de Waals forces, cell surface charge and cellular hydrophobicity. Tight or irreversible adhesion follows, mediated by the likes of adhesins, which in the case of *Candida* are mainly mannoproteins. Experimental animal models show *Candida* attachment to the surface of the smaller intestine in approximately 20 minutes, further penetration of the epithelium assisted by hydrolytic enzyme release and potential dissemination may occur within three hours. Although hydrolytic proteases play an important role in compromising host defences, phospholipases should also be considered amongst

Table 1 Species commonly causing invasive Candidiasis

Organism	Comments	Incidence
Candida albicans	Most opportunistic fungal infection of the Candidas. First reported in 1853	>50%
Candida tropicalis	Most common Candida species in India. First reported in 1910	15 - 30%
Candida glabarata	Shows marked resistance to fluconazole	15 - 40%
Candida parapsilosis	Infections associated with invasive devices. First reported in 1917	15 - 30%
Candida krusei	Shows some resistance to fluconazole	10 - 35%

Other human pathogen Candida species include: *Candida lusitaniae, Candida guilliermondii, Candida kefyr, Candida rugosa, Candida dubliniensis, Candida zyelanoides*

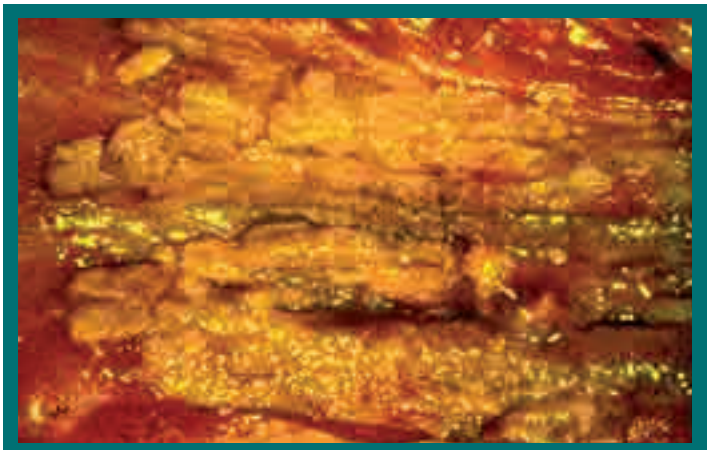

Fig.1: *Candida oesophageal overgrowth*

Table 2 Predisposing factors to Candidiasis

- Pre-existing disease state: patients with HIV/AIDS, maligant tumours*, leukaemia and diabetes.
- Immunosuppressed patients through chemotherapy*, and graft (marrow, kidney, liver) transplantation.
- Catheterization: central venuous cathethers*, bladder catheters
- Intravenous drug abuse
- Burns: certain reports indicate 60% of burns/dressings associated with *Candida* presence
- Antibiotic/imprudent antibiotic usage*

***many of these states and conditions interrelate and interact**

Candida virulence factors. Tissue invasion and haemolysis by *Candida* strains is associated with an ability to produce phospholipases, enzymes capable of disrupting the phosphate component of fatty acids, thereby compromising membrane integrity and function.

Candida has the capacity to survive certain host strictures like low iron levels, sometimes termed nutritional immunity, through production of iron-chelating agents and possible exposure of membrane proteins required to internalise said chelating agents. However elements of both innate and adaptive vertebrate immune systems readily target the mannose component of *Candida* cell walls. Unimpaired human immune systems, through a complex series of interactions potentially leading to phagocytosis by the likes of macrophages, effectively destroy invading *Candida* cells. In contrast, those with impaired immune systems particularly T-cell function, are at great risk of mortality through the likes of septicaemia, as some estimates consider *Candida* infection to be the cause of death in 20% of AIDS patients.

In common with susceptibility to *Candida*, the immunocompromised are at grave risk of cryptococcosis, infections mediated by the yeast *Cryptococcus*. This yeast is not restricted to humans alone and can be isolated from a variety of domestic and wild animals. Rare amongst yeasts, this organism shares taxonomic features common to large and edible fungi like mushrooms, which some consider to be the most sophisticated of fungi. Although 38 species of *Cryptococcus* have been isolated and characterised, only one species of two strains or subspecies namely

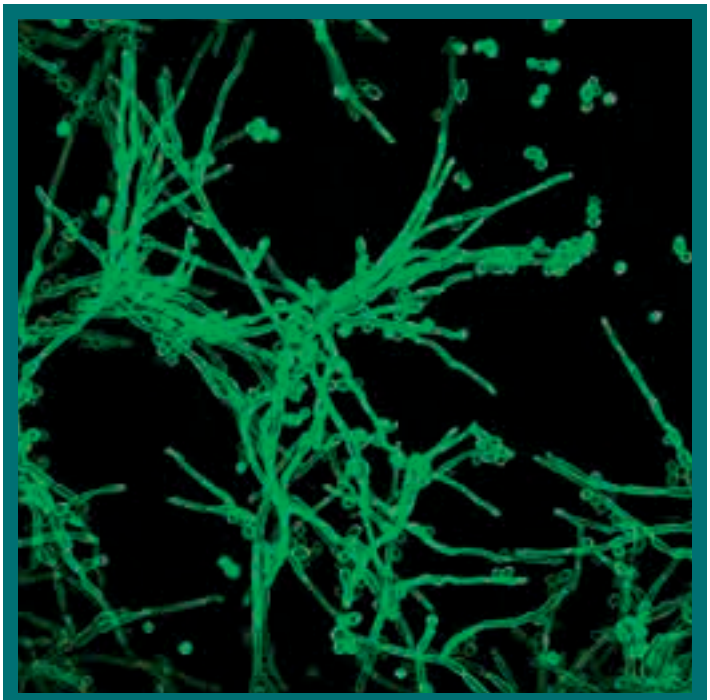

Fig. 2: *Filamentous and unicellular forms of Candida albicans complexed with mannose specific FITC-lectin*

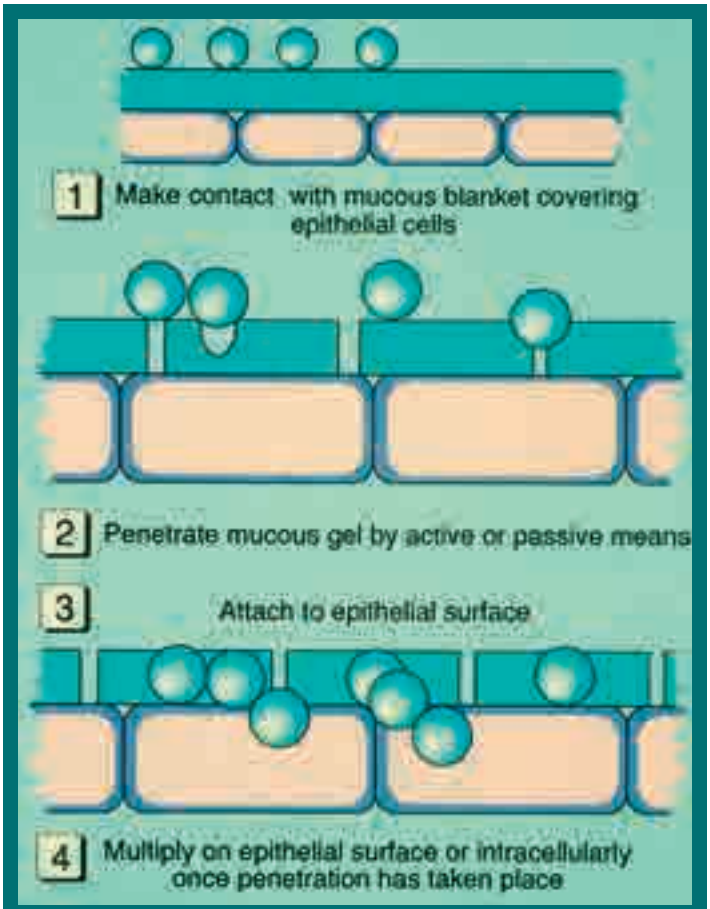

Fig. 3: *Diagrammatic outline of Candida penetration of the GI tract*

Cryptococcus neoformans vr neoformans and *Cryptococcus neoformans vr gattii* are capable of human infection. Incidence of cryptococcosis within the global human population, in common with other fungal infections, is hard to quantify, due to poor monitoring particularly in developing countries. Within developed countries, where adequate monitoring exists, it is nowhere near as common as candidiasis. US public health reports from the CDC indicate that in the 1980s there were on average only 730 cases per annum across the whole of the USA.

As an opportunistic pathogen in the mould of *Candida*, a number of predisposing factors including pre-existing disease state or therapeutic practice promote *Cryptococcus* incidence. Infection rates of 2.8% have been reported for organ transplant recipients of the developed world of which 42% have died. Under such circumstances continued low incidence of *Cryptococcus* must be an abiding wish, as once *Cryptococcus* is established the outcome for those infected appears grim. However, as medical practitioners embrace ever more technologies and esoteric protocols, associated with the likes of organ transplantation and cancer chemotherapy, the numbers of immunocompromised individuals increase so *Cryptococcus neoformans* infection rates will inexorably rise.

From the 1980s cryptococcal infection rates increased in US HIV patients to levels of 5-10% of all AIDS sufferers. Rates vary on a global basis, in Europe the % frequency amongst AIDS patients is somewhat lower, contrastingly what reliable data exists from Africa indicates 30% cryptococcal

infection amongst AIDS patients, who may only survive for two weeks without suitable antifungal treatment. Antifungals can ameliorate infection and extend patient longevity however *Cryptococcus* remains the 4th most common cause of death amongst AIDS patients.

Many cases of cryptococcosis are not diagnosed until signs of meningitis appear. The lungs are commonly considered an initial site of infection through inhalation of yeast cells or dust contaminated with such cells giving rise to a primary pulmonary or lymph nodule. Cryptococcal infections like those of *Aspergillus* have been termed "pigeon fanciers lung" as birds and their guano are a common source of infection. Levels of viable *Cryptococcus* cells in pigeon faeces can reach 50 million cells per gram guano. Furthermore a study has shown that cryptococcal cells remain viable and potentially infectious in dried bird droppings for over 400 days.

The nodule may lie dormant for an indefinite period and frequently resolve in healthy individuals without recourse to treatment. However, in the immunocompromised pulmonary cryptococcosis develops rapidly into disseminated infection in the form of many pulmonary nodules with associated symptoms of fever, malaise, chest pain, dyspnoea and weight loss. Amongst AIDS patients, infection of the brain and the meninges is the most common clinical manifestation of cryptococcosis. Mental abnormalities and changes follow including, drowsiness, confusion, headache, a rise in intercranial pressure, septic shock and death.

From the standpoint of a microbiologist and mycologist *Cryptococcus* appears the ultimate human yeast pathogen, exhibiting many of the attributes theoretically associated with a destructive and robust entity. Table 4 lists the many and potent virulence factors manifest by *Cryptococcus* hence its relatively uncommon nature remains puzzling. While all these factors deserve attention the unique in fungal terms capsule of *Cryptococcus* deserves particular investigation. The capsule is composed of three carbohydrate moieties, upwards of 88% of the capsule is glucuronoxylomannan (GXM) with smaller contributions from galactoxylomannan and mannoprotein. These are large molecular weight but viscous polysaccharides, hence the capsule is continuously shed, resulting in detectible quantities appearing in patients sera and cerebrospinal fluid. Poor affinity amongst lectins and other biological entities, which are specific for mannose, is a defining characteristic of GXM, even though mannose is a major GXM component. Although the capsule may have arisen to protect cells from desiccation or protozoan predation, its presence has marked consequences for those infected by *Cryptococcus*. Important elements of innate vertebrate immunity including mannose binding lectin (MBL) are rendered virtually redundant, furthermore GXM is also poorly immunogenic, hence terms such as "immunological paralysis" have been coined to describe the poor immune response of animal models exposed to *Cryptococcus*. Such is the apparent value of the capsule to *Cryptococcus* one can only speculate why it is such a unique feature amongst yeasts in general.

Pathogenic yeast merit our continued attention and constant vigilance, particularly with ever increasing numbers of immunocompromised patients and the commonplace use of intrusive devices. Furthermore their suppression and control remain problematical as in comparison to numbers of antibacterial therapeutics few efficacious antifungals are available, in part a consequence of the common eukaryote nature of yeast pathogen and human host. Favoured agents such as amphotericin are associated with poor patient tolerance or very expensive when formulated in more tolerated forms while resistance to other major antifungals such as azoles can develop in days. In the light of such circumstances human infection by pathogenic yeast will remain at best problematical and at worst life threatening.

Table 3 Putative members of the *Candida albicans* Virulence Panel

- Rapid switching of expressed phenotype
- Hypha and psuedohyphal formation
- Thigomotropism
- Surface hydrophobicity
- Surface virulence molecules - receptors, adhesins, immunomodulators
- Molecular mimicry - host like surface components
- Lytic enzymes - proteinases, phospholipases and others
- Growth rate
- Undemanding nutrient requirement

Table 4 Virulence factors of *C. neoformans*

- Capsule
- Melanin synthesis
- Resistance to dessication
- Growth at 37°C
- Mannitol synthesis
- Proteinase secretion
- Phospholipase
- Urease

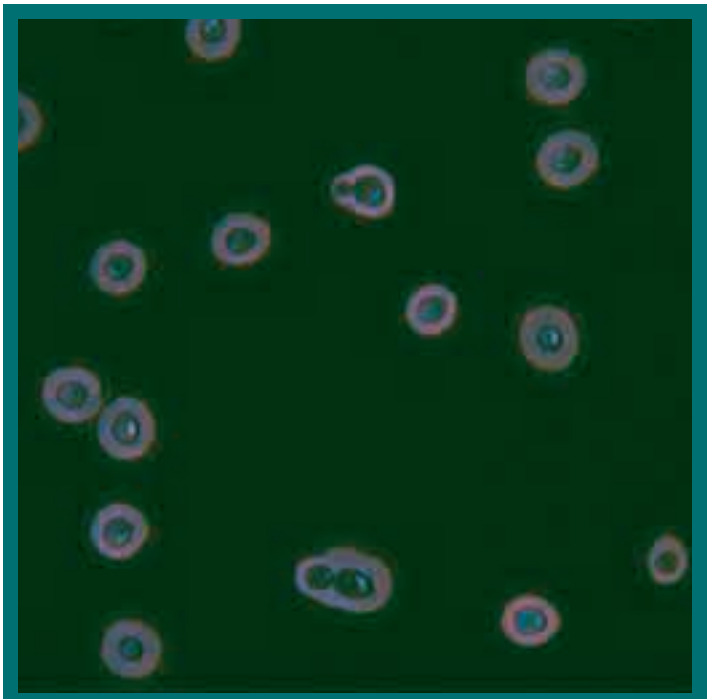

Fig. 4: *Cryptococcus neoformans and associated capsule as visualised by indian ink staining*

Steve Smith
Molecular Biosciences
Aston University

Material Transfer Agreements

Peter Green asks whether Material Transfer Agreements are a modern day necessity or a pain in the butt for culture collections and scientists alike?

AS PART OF today's ever changing world, more and more culture collections are having to wrestle with increasingly complex issues, from postal regulations to the impact of the Convention on Biological Diversity (CBD). Another such issue causing food for thought governs the transfer of scientific materials, either from one culture collection to another culture collection, or from collections to their customers.

Transfer of cultures in this way is increasingly becoming subject to **Material Transfer Agreements** (MTA's). In many ways these MTA's are a replacement for the old 'conditions of sale' information which accompanied many cultures you will have received in the post. Most of us don't even bother to read such documentation and instead confine them to the bin without a backward glance. However, senior management of more and more culture collections are having to both produce their own MTA's and carefully review any which may be associated with new incoming materials. The reasons for these activities is partly economic and partly legal. It is in a culture collections interest to encourage scientists to buy cultures and not to *"pass sub-cultures around for free."* As part of the CBD, it is also in the interests of the depositor or government of the country of origin of such cultures to share in any commercial benefits which may arise from commercial exploitation of that culture.

However, the overriding worry is that such documentation, protocols or associated legislation runs the risk of severely restricting both the hitherto free movement of cultures among colleagues within the scientific community and the use to which they can be put in a commercial sense. Some collections, for example, now require their customers to provide written acknowledgement that recipients of cultures have read, understood and will comply with conditions laid down in MTA's. As intimated above, some MTA's have ramifications should you commercially exploit a culture and/or wish to pass a culture on to a third party.

However, an altogether more worrying extension to this has been a recent move by the American Type Culture Collection (ATCC) to draft an MTA which governs exchange of materials between collections. Until now, many collections have always operated a 'gentleman's agreement' to allow the limited exchange of important reference materials between collections, on the premise that these materials should be freely available within the scientific community. Other activities such as those prescribed in the Bacteriological Code governing the publication of new species descriptions, mandates that strains of new type species are deposited in at least two separate culture collections (the purpose of the latter being to make sure that strains are made widely available — *"held in trust for science"* — as the Zoological Code puts it). The ATCC MTA is in danger of stifling both these activities, and who knows, other culture collections may follow suite.

On a personal level, I have written to the ATCC pointing out the ramifications of their inter-collection MTA and am currently trying to persuade them to reconsider their position.

These are worrying times for us all and we need to be aware of changes which affect the acquisition and use of everyday tools of the trade and to voice our views at the highest levels of government if we are unhappy with changes which affect or restrict our usage of micro-organisms. These views need not only be expressed at the national level, but also could and should be aimed or aired at appropriate international fora as well. Above all we need to ensure that while it is entirely proper for culture collections to protect vital underpinning revenue generation from sale of cultures and for national 'ownership' of biological materials to be recognised and for stakeholders to enjoy participation in some form of benefit sharing as a result of commercialisation of said cultures; this has to be done in a sensible and well thought out manner. That is, assuming we all wish to continue to enjoy the unhindered flow of materials for scientific usage and the part they may play in the development of new and novel biological products. Let us hope common sense and balance are the watchwords as this new era evolves.

Peter N Green
is curator at NCIMB and he can be reached at p.green@ncimb.co.uk

Looking for funding to host a microbiological meeting in your area?

The "Regional Meeting Grant" award could be the answer!

SfAM and SGM have joined forces to jointly sponsor meetings aimed at promoting microbiology at regional level to members and to the wider community. The Societies will cover the costs, up to a value of £2,000, and may also offer a prize for the best young scientist presentation at the event. The format of the meeting can be flexible. It could be a one day scientific meeting on a particular topic, alternatively, regional group meetings could be established. These meetings should aim to be inclusive rather than exclusive and should bring together senior academics, students, local equipment manufacturers, EHOs, hospital staff, local industry etc. For more information and application forms visit the Grants and Awards section of the Society website at: **www.sfam.org.uk/members/prizes.php**

European BioSafety Association

The European BioSafety Association (EBSA) was founded in June 1996. It is a not for profit organisation which aims to provide a forum for its members to discuss and debate issues of concern and to represent those working in the field of biosafety and associated activities. To date, the Association has over 300 individual members and around 20 Corporate members, representing over 15 countries in Europe, as well as the United States and Canada.

EBSA is committed to enhancing the knowledge and understanding of biological safety issues throughout Europe and the world. It strives to establish and communicate best practices amongst its members and to encourage dialogue and discussions on developing issues. EBSA will seek to influence and support emerging legislation and standards in the areas of biological safety, biotechnology, transport and associated activities and will act as a focal point for the consolidation of views on these issues. EBSA will strive to represent the interests of its members in all areas relating to biosafety, with the objective of ensuring the prevention of harm to man or the environment from biological substances or materials.

BENEFITS

EBSA will strive to secure the following benefits for its members:

- official representation on national and international committees to lobby for the interests of EBSA members
- Official consultation on emerging legislation and standards to influence the outcome of such regulations and to ensure that emerging standards are not only scientifically supportable but also represent best practices
- develop and provide supporting training materials and activities to ensure EBSA members are aware and informed of new issues and areas of research
- to support the principle of continuous professional development for its members.

CONTACT

EBSA Secretariat,
Deefstraat 19, B-1880
Kapelle-op-den-Bos,
Belgium.

Tel +32 15-71 10 37
Fax +32 15 71 31 89
Email mdc@net4all.be
Website.www.ebsa.be

Mairi Hope explores the new genetic fingerprinting technique of DGGE and predicts it will become a core facility within every microbial ecology lab

Density Gradient Gel Electrophoresis

IT IS NOW ACCEPTED THAT the vast majority of microbes have not yet been isolated, identified or characterised. This is largely due to a lack of knowledge of how these organisms survive and grow in natural habitats. When one also considers that a bacterium is often part of a larger more complex community or ecosystem with possible co-dependence on other members, it is understandable why traditional culturing techniques fail to accurately reflect the large microbial diversity in an environmental sample.

The advent of culture-independent techniques has transformed the field of microbiology and microbial ecology in particular. PCR-based techniques allow the classification of microorganisms based on particular genetic markers and the profiling of complex microbial communities on the basis of sequence diversity (including the uncultured majority). One technique that is now routinely used is denaturing gradient gel electrophoresis (DGGE) (and the analogous temperature gradient gel electrophoresis (TGGE)).

DGGE is a genetic fingerprinting technique that is used to separate individual sequences from a complex mixture. DNA sequences with differing base composition have different melting properties when passed through an acrylamide gel containing an increasing gradient of chemical or thermal denaturant. The melting temperature of a double stranded DNA fragment is influenced by hydrogen bonds formed between complementary base pairs and also by the attraction between neighbouring bases on the same strand (known as stacking interactions). The order of bases on a strand determines the degree of stacking. A DNA molecule may therefore have several melting domains with characteristic melting temperatures (T_m) determined by the nucleotide sequence. Changes in base sequence as small as a single base may alter the stacking significantly enough to modify the T_m by over 1°C. When separated by electrophoresis through a gradient of increasing temperature (TGGE) or chemical denaturant (DGGE — usually formamide and urea), the mobility of the molecule is retarded at the concentration at which the DNA strands dissociate, forming a partially single stranded molecule with no further movement in the gel. Complete denaturation is prevented by the presence of a high melting domain, which is usually artificially created at one end of the molecule by incorporation of a GC clamp. This is produced by using a primer with a 5' tail consisting of a GC-rich sequence of around 30-50 base pairs in the PCR (Myers *et. al.*, 1985). In principle, this means that DNA fragments of the same length are separated on the basis of differing sequences, even if only by a single base. The separation of the DNA fragments is then visualised by staining. The most sensitive method of detection is silver staining, however this prevents any further analysis of bands by techniques such as sequencing or hybridisation analysis. Alternative staining methods are ethidium bromide or SYBR green.

The most commonly used marker for profiling bacterial communities is the small sub-unit or 16S rRNA gene. The size of this gene (1.5 kilobases) is large enough for reliable phylogenetic information. Ribosomes are evolutionary and functionally conserved and are found in all living cells. Due to functional constraints, the sequence over certain areas of this gene remain conserved throughout all evolutionary lineages but interspersed with variable or hypervariable regions of sequence. This allows for the design of hierarchal primers, which can target broadly (e.g. the domain bacteria) or with high specificity (e.g. the genus *Pseudomonas*). Different functional genes can also be used in order to target specific groups of bacteria, for example the *amoA* gene present in ammonia oxidising bacteria and the *iap* gene for *Listeria* species (Avrahami & Conrad 2003; Ercolini 2004).

Profiles generated by DGGE (figure 1) can be analysed by comparing the presence or absence of individual bands as well as measuring the intensity of a

Figure 1: *DGGE of PCR products of the V6 to V8 region of 16S rDNA from various human colonic biopsy samples.*

band within a profile, where the intensity can relate to the relative abundance of a sequence within a sample, although at best this is considered a semi-quantitative measure. By performing RT-PCR and subsequent DGGE analysis on the same sample, one can also determine expression levels and compare activity of the more prominent bacteria within the profile (Zoetendal, Akkermans, & de Vos 1998). Single bands may also be excised and sequenced in order to ascertain the identity. Furthermore, statistical analysis of the banding profile can be performed using computer software packages to generate similarity indices leading to more refined results (Fromin *et al.*, 2002).

It should be noted that as with all PCR-based analyses, DGGE is not without its limitations. In general, for optimal resolution the fragment size of the PCR product generated prior to DGGE analysis is limited to a maximum of around 500bp. This means that definitive species identification from databases may not be possible. Difficulties have also been reported in attempting to resolve fragments that differ by only two or three bases, yet co-migration of non-related sequences has also been reported. Microheterogeneity in rRNA encoding genes present in some species must also be taken into consideration where multiple bands for a single species can subsequently lead to an overestimation of community diversity (Muyzer & Smalla 1998).

One of the main advantages of DGGE is that it allows the simultaneous analysis of multiple samples, making it feasible to monitor shifts in populations over periods of time or different environmental conditions. Before the arrival of DGGE this was more commonly achieved by cloning and sequencing - an approach that is both labour intensive and relatively costly, especially when dealing with numerous samples.

The DGGE method was first used to profile communities of a microbial mat and bacterial biofilms (Muyzer, de Waal, & Uitterlinden 1993) and since then has been used to analyse microbial communities from extremely diverse microbial environments too numerous to mention. A few examples include profiling of microbial soil communities, marine environments, hydrothermal vents, the gastrointestinal tract of humans and even the study of a microbial community resident in a medieval wall painting (Felske *et al.*, 1997; Hold *et al.*, 2001; Nicol, Glover, & Prosser 2003; Zoetendal *et al.*, 2002). More recently, DGGE has been introduced into food microbiology for the identification of microorganisms isolated in food and for evaluation of the microbial diversity during food fermentation.

In conclusion, DGGE has proved to be an exceptional tool to study species diversity and bacterial community dynamics. Despite the fact that it is still a relatively new technique within microbial ecology, its relative simplicity and reproducibility means that DGGE will no doubt become a core facility within every microbial ecologists laboratory.

Mairi Hope
University of Aberdeen

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Peter Gilbert and **Alex H Rickard**
discuss the arcane subject of bacteal aggregation into biofilms

Biofilms...

where Angels fear to tread

WORKING LUNCHES at the *Dog and Duck* will never be the same again. Once the place to retreat, to escape inane questioning by undergraduates, and to ponder the meaning of life, it has now become a hotbed of philosophical debate. The topic, are biological events driven by chance or by necessity? Sadly, rather than discuss the juxtaposition of Darwinian and Lamarkian thinking, the biological events at the centre of this controversy relates to the propensity of bacterial cells to stick to one another (Rickard *et al.*, 2003). To those of us who work with pure cultures this property is an annoying feature of the late stationary phase. For many of our favourite laboratory work-horses such "clumping" undermines the co-incidence between viable counts and the number of colony forming units and has the potential to infer an apparent resistance to disinfection. We therefore endeavour to select strains that are deficient in the clumping trait (easily done with repeated passage in laboratory media), or we spin and shake, to wash-off the natural bits, and resuspend the now denuded cells in isotonic salts.

To other, more enlightened, microbiologists the ability to self-aggregate is a highly evolved mechanism by which bacterial cells may couple and pass on heritable traits. For the imaginative, aggregation reflects a primitive drive towards multicellularity and the formation of microbial tissues. Regardless, aggregation between physiologically distinct partners allows cooperative communities to be established in environments as diverse as the gut, mouth, river sediments and industrial pipework, even, perish the thought, those channelling beer through the *Dog and Duck*.

In spite of a general preoccupation with single cells in planktonic phase there is a wealth of literature available that deals with the particular properties of microbial aggregates and of their applications in applied microbiology. Thus, flocculation of yeast cells is an essential element of the brewing industry, and the formation of activated sludge vital to sewage treatment. The latter is truly polymicrobial with fastidious, obligate anaerobes lying protected within castellated aggregates formed by strongly aerobic partners. These flocks possess a collective metabolism that greatly surpasses that of the individual component species.

Within most ecosystems the greatest bioactivity happens, not in suspension but with organisms firmly associated with interfaces. When polymicrobial aggregates form at interfaces they are often referred to as biofilms and, by virtue of this epithet, highly fundable.

A whole new vocabulary has emerged to describe the various nuances of stickiness relating to biofilm formation. With the emergence of each new term, tenuous assumptions made about their determinative nature and causality become more dogmatic. Autoaggregation (attachment of one species to its clonal decendents) is distinguished from coaggregation (attachment of different species to one another), yet the ability to autoaggregate precludes the laboratory assessment of coaggregation. Where aggregation is between benthic (sedentary) and planktonic cells (floaters) then it is referred to as coadhesion, as is aggregation in disperse, planktonic, phase followed by attachment to the surface. Distinctions made between coadhesion and the attachment of multispecies flocs, however, leads to the assignment of temporal sequences to biofilm formation and the identification of primary and secondary colonisers. The surface appendages involved in intercellular adhesion are either polysaccharides or proteins, and the former class are described as receptors whilst the latter are described as adhesins. The use of such terms respectively imposes passive and active elements to the coaggregative relationship, and implies selective advantage gained by individual partner organisms. Are such interactions simply the result of chance, after all the cell envelope must interact with a complex extra-cellular milieu, that would include inert surfaces and dissolved materials such as sugars and peptides, or are they a necessary part of multicellular behaviour and subject to the laws of natural selection?

Since it has been demonstrated that coaggregation is a common phenomenon within a wide variety of multi-species biofilm communities, then its ecological significance deserves assessment. The key assumption must be that the strength and specificity of the interactions will be subject to natural selection forces and will reflect the degree of benefit, or harm, conferred upon bacterial partnerships by coaggregation. Those bacteria that benefit from living within a coaggregated community will survive and proliferate,

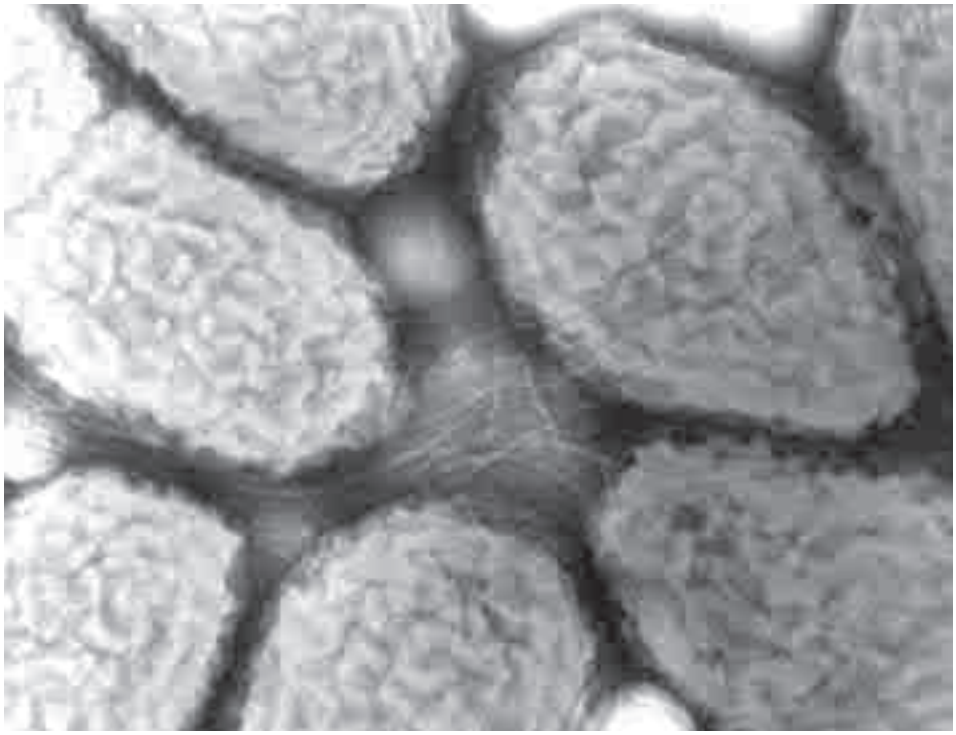

fig 1. *Vision of autoaggragation: Sphingomonas natatoria grown in pure culture and demonstrating the propensity to autoaggregate in rosettes through surface associated fimbriae clearly visible within the central region of the micrograph*

Photograph courtesy of P S Handley and A H Rickard

better than the corresponding single, non-coaggregated cells. Thus, where organisms in a partnership possess complimentary metabolisms that enable them to collectively utilize available substrates more efficiently than any competing single organism, then coaggregation will not only maintain a close proximity of cells, and exclude competition, but it will also allow the partnership to proliferate and to co-emigrate to new situations. Where such mutualism is not demonstrated then local competition for nutrients will place the partners at a disadvantage. Mucin is a complex substrate for which complete catabolism requires the mutualistic action of several different oral species possessing complimentary yet overlapping enzymic activities. Thus, Palmer et al. (2003) showed that *Streptococcus oralis* and *Actinomyces naeslundii* form nutritionally beneficial coaggregates that, in the human mouth, facilitate growth where neither organism was capable of growing independently. This supports the earlier in-vitro observations of Bradshaw *et al.*, (1994), that such metabolic co-operation results in the liberation of additional nutrients, and that this may help to maintain the characteristic diversity of biofilm communities found in many natural habitats. Clearly, in such relationships the close proximity of participating organisms, brought about by coaggregation, maximizes the efficiency of the consortium. Caldwell *et al.*, (1997) have taken this concept several stages further and argue that polymicrobial consortia should be considered as evolving units in their own right, selected for on the basis of their combined functional efficiency. This proliferation hypothesis transcends Darwinian evolution by condoning mutualistic partnerships rather than encouraging competition and survival of the fittest. In such a fashion it has been argued that the eukaryotic cell, with its prokaryotic mitochondrial ancestry, epitomizes the partnership as a successful evolutionary unit.

Five years ago coaggregation of bacteria was mainly the preserve of the oral microbiologist. Coaggregation offered the potential to explain the exquisite patterns of differentiation and maturation found within supragingival plaque; primary and secondary colonizers were identified that together with polygamous adherent species such as *Fusobacter nucleatum*, could be used to draw up temporally-interactive

fig 2. *Coaggregated multispecies biofilm formed on a surface glass immersed in liquid culture medium following inoculation with Spingomonas natatoria and Micrococcus luteus. Only the Sphingomonas is capable of autoaggregation, albeit weak (see fig 1). Coaggregation therefore leads to the formation of structured mosaics of biofilm at the colonised surface*

Photograph courtesy of P S Handley and A H Rickard

plaque networks (Kolenbrander, 2000). Such networks strongly implicate coaggregation as the moderating-process most closely involved with plaque development. Today the concept has been found to be equally persuasive in providing explanations for the presence of stable communities within freshwater ecosystems, and within human and animal gastrointestinal and urinary genital tracts (Rickard *et al.*, 2003a). Whilst there are many similarities between coaggregation of dental plaque bacteria and those of other ecosystems there appears to be one major difference. Whereas oral microorganisms are generally constitutive expressers of the aggregative phenotype, fresh-water isolates expressed this optimally only during the stationary phase of growth, exponentially growing cells being incapable of coaggregation. The ability to switch the coaggregation phenotype 'on and off' could indicate some form of environmental control of expression of adhesins and/or receptors through starvation and stress. This leads to a 'Mechano-kit' model of microbial communities where each component species evolves separately but that multispecies aggregates appear temporarily in response to the prevailing nutrients (Wimpenny, 2000).

The proliferating units disperse once the advantages of communal life disappear. Reproductive success then depends upon the ability of individual species to both make and break partnerships. Presumably, in the mouth, loss of adhesion would ultimately result in oral bacteria being swallowed and digested thereby driving a strong selection pressure towards the constitutive expression of a coaggregative phenotype. In the immortal words of Tom Lehrer, *'Fish have got to swim and birds have got to fly, but they don't last long when they try'*.

In a simple experiment involving a fish tank and a re-circulating high-pressure water pump it was noticed that the most luxuriant and extant biofilm was formed where the hydrodynamic shear forces were greatest (Rickard *et al.*, 2003b). This was consistent with the hypothesis that biofilms formed under high shear are subject to a selection pressure that favours coaggregation partnerships. In fast-flowing rivers or the mouth, then if this did not happen the organisms would be washed away from their optimum ecological niche. Further experiments were conducted using a Concentric Cylinder Reactor to control hydrodynamic shear force, and biofilms established over three months using direct, potable water feeds. These showed, not only that the species diversity of the communities was inversely related to hydrodynamic shear force, but also that under high shear aggregative networks were optimized.

For the reasons outlined above specific coaggregation processes are likely to have an important ecological role as an integral process in the development and maintenance of mixed biofilm communities. The evidence available so far strongly suggests that this is true for dental plaque and probably for freshwater biofilm communities. Whilst only time will tell how widespread coaggregation is among other multi-species ecosystems, it may turn out to be a very widespread and truly ancient phenomenon.

Our thanks to SfAM for providing financial support (Student into Work Scheme) to Ms Amy Stead, a final year microbiology student, enabling her to work with us last summer. This allowed her to follow up ideas on the role of coaggregation in freshwater ecosystems using the Concentric Cylinder Reactor. Our thanks also go to the Presidents Fund, without the help of which one of us (AHR) would have been unable to present the findings to the 104th Annual General Meeting of the American Society for Microbiology in New Orleans. Our musings on life, the universe and everything can temporarily relocate from the *Dog and Duck* to warmer surrounds.

Peter Gilbert and Alex H Rickard
School of Pharmacy
University of Manchester

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Glasgow Virology Workshop

David J Evans reports on a one day workshop held at the University of Glasgow on 7th February 2004

THIS ONE DAY ANNUAL workshop, now in its ninth year, is designed to encourage scientific interactions between the many virologists based in Scotland. However, as in previous years, members of the virology *cognoscenti* travelled from much further a field for an enjoyable day of research talks and discussions. Our tried and trusted formula consists of four scientific sessions, containing an eclectic mix of subjects, with ample time for questions and conversation.

Dr Kim Green, National Institutes of Health, Bethesda, USA

The framework for the meeting was provided by three excellent plenary presentations from Prof. Stuart Siddell (University of Bristol), Prof. Ulrich Koszinowski (University of Munich) and the SGM/SfAM-sponsored speaker, Dr. Kim Green (NIH, Bethesda, USA). Prof. Siddell's presentation on *"SARS: A lesson to be learnt"* discussed the history, epidemiology and molecular biology of this novel virus, and emphasised the need for both constant vigilance and scientists versed in conducting fundamental research to help combat future threats. Prof. Koszinowski's talk on *"Evasion, subversion, modulation: Functions affecting the virus host interface"* illustrated powerful techniques to modify the murine gammaherpesvirus genome, and the insights that can be obtained by combining such in vitro approaches with a tractable animal model system. By way of a contrast, Dr. Green described the problems encountered in studying replication of certain caliciviruses which cannot be propagated in culture in her presentation entitled *"Models for the study of calicivirus replication"*. Interspersed with these were a dozen shorter presentations on subjects as wide-ranging as the epidemiology of Menangle virus in pigs and fruit bats, HIV infection of CD8 lymphocytes and the evolution of the herpesvirus genome. These talks included current studies from Glasgow, Edinburgh, St. Andrew's and Dundee, and reflected the broad range of active virology research in Scotland. Many of these presentations were by younger researchers and — thanks to the generosity of the SGM/SfAM — could be considered for the *Microbiology Communication Prize*. Despite the very high standard of presentation by all eligible speakers, the judges had no hesitation in deciding that Nicola Stock should receive the award for her talk entitled *"Paramyxovirus V proteins and the interferon response"*.

Nicola, a final year PhD. student with Prof. Rick Randall in St. Andrew's, completed a memorable day by also winning the prize draw on the Qiagen trade stand.

Nicola Stock receives her SGM/SfAM Microbiology Communication Prize certificate from David Evans

The 150 registrants continued their socialising at a wine reception, before braving the cold and snow of a raw February Glasgow evening.

David J Evans
University of Glasgow

Microbial interactions with Medical Devices: a Matter of life and Death

Bee Ann Yeap, a recipient of a Society Studentship grant, reports on her experiences at the SFAM January meeting held in Newscastle on 7 - 8 January 2004

THE JANUARY MEETING of the Society for Applied Microbiology highlighted the most recent advances in the understanding of the mechanisms of microbial interactions with medical device surfaces. Orthopaedic, ophthalmic and dental devices are prone to develop microbial biofilm when implanted in the body. Substrates for biofilm-related infections can include the surfaces of catheters, medical implants, wound dressings, or other types of medical devices. This is a current problem but is progressively becoming more significant.

The contamination of surfaces and possible cross-infection are important considerations for patients but also for the healthcare professional. This is particularly pertinent since there is an increase in usage of medical devices, including implants. Bacteria are usually associated with surfaces where they grow mainly as a biofilm. Bacterial adhesion followed by colonisation on the surface generally leads to the development of a biofilm. Almost all surfaces which are exposed are colonised by microorganisms but infection takes place only in a relatively small number of cases. Some speakers analysed the causes that lead to the development of infection in different scenarios. In particular, the problem of antibiotic resistance was addressed in consideration of the relatively low efficacy of these antimicrobials towards bacteria developing as a biofilm. Consequently, very high and/or long-term doses are often required to eradicate biofilm-related infections.

There are several factors that promote the colonisation of microorganisms but the main cause is the implantation of the medical device in an environment favouring bacterial growth. In addition, once the colonisation of microorganisms occurs, they become more resistant to antimicrobial agents. As a result many methods have been developed to reduce the initial bacterial adhesion to medical device surfaces.

One approach is for the medical devices to release an effective concentration of antibacterial agents during the entire period of implantation to avoid bacterial colonisation that will lead to the formation of biofilm. Photo-activated disinfection has been used to investigate the antibacterial effects related to dental disease.

The reduction of bacterial adhesion to implanted medical devices can also be achieved by using biomimetic surfaces. The biomimetic surfaces mimic the natural cell membrane to improve biocompatibility of the medical device. Research has also lead to the study of polymers, which are a class of materials that can be manipulated easily to achieve the properties wanted for particular

applications. There are many different types of polymers that are being used for medical device applications. Polymers can be functionalised and modified to produce more compatible materials.

Other speakers focused on defined examples such as intravascular and urinary catheters and contact lenses.

The use of intravascular catheters can put patients at risk of local and systemic infectious complications, including local site infection, catheter related bloodstream infection (CR-BSI), septic thrombophlebitis, endocarditis, and other metastatic infections. The majority of serious catheter-related infections are associated with central venous catheters (CVCs). The incidences of infection are often higher with patients that are in a chronic condition rather than in the less acute in-patient. Also, central venous access might be needed for extended periods of time; patients can be colonized with hospital-acquired organisms and the catheter can be manipulated several times daily for the administration of fluids, drugs, and blood products. *Staphylococci* or *enterococci* are usually the source of infection. Teflon® or polyurethane catheters have been associated with fewer infectious complications compared with catheters made of polyvinyl chloride or polyethylene. Certain catheters are also coated or impregnated with antimicrobial or antiseptic agents that can decrease the risk of CR-BSI. Minocycline-rifampin and chlorhexidine-silver sulphadiazine containing catheters have both been shown to reduce CR-BSI compared with uncoated / unimpregnated CVCs. Even though these impregnated catheters show reduction in CR-BSI, the clinical benefit remains to be demonstrated.

Urinary catheters are almost always associated with urinary tract infections. Urinary tract infections are one of the most common nosocomial infections. They include a wide variety of clinical conditions such as cystitis and acute and chronic pyelonephritis. Complications can include kidney infections, bacteraemia and sepsis. Catheter associated urinary tract infections have been shown to prolong the mean length of hospital stays from 2.4 to 4.5 days, and are associated with an increase in-hospital mortality. Interventions to prevent catheter related urinary tract infections have focused on preventing intra-luminal or extra-luminal entry of microorganisms into the urinary drainage system, and the introduction of organisms during insertion of the catheter. Antimicrobial-coated catheters have also been utilised to minimise the risk of infection.

Contact lenses, disinfection solutions and storage cases can easily become contaminated with bacteria and fungi. Most lenses are coated with a biofilm that is resistant to many surfactant cleaning agents. Microbial growth can be associated with eye infection. One of the worst infections is microbial keratitis, which is an inflammation of the cornea. Bacteria are able to adhere to the lens simply by handling and when it is inserted into the eye the bacteria will be transmitted to the cornea. Bacteria that are most commonly transmitted from the lens surface are Pseudomonas aeruginosa and Staphylococcus aureus.

Intraocular lens-related infection like endophthalmitis localises around the implant and lens capsule. *Propionibacterium acnes*, *corynebacteria* and *Staphylococcus epidermidis* can be associated with this infection. In addition, these microorganisms respond poorly to conventional antibiotic therapy when attached to the implants. The eradication of the infection requires the removal of the vitreous and posterior lens capsule or the removal of the implant within the capsule. A biofilm related infection is the infectious crystalline keratopathy in which pathogens grow between the corneal lamellae without exciting an inflammatory response. This results from the use of topical steroids and antibiotics with treatment often requiring keratectomy.

The presence of a microbial biofilm remains a serious clinical problem since it can increase the risk of infection from medical devices and implants. It is hoped that the problems associated with medical devices will slowly fade with the development of many different methods to prevent colonisation of bacteria on surfaces.

In conclusion, the conference was highly beneficial for me as it gave an overview of the recent developments within my field of research. I have also gained from the topics that were less relevant to my research project, because they were interesting and well presented. Overall, the conference was interesting and I thoroughly enjoyed the experience.

Bee Ann Yeap
University of Brighton

The Society offers FULL members an opportunity to give undergraduate students of microbiology the chance to obtain work experience during the summer vacation. Grants can be made available to ANY FULL member who is able to offer a suitable undergraduate student a work placement for a period of up to 10 weeks during summer. The grant is £160 per week for the student for a maximum of 10 weeks and up to £50 per week for lab costs for a maximum of 10 weeks. To apply, visit **www.sfam.org.uk/members/prizes.php**

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1. Any full member of the Society who can offer an undergraduate student, or a recent graduate (within 6 months of graduation) a work placement is eligible to apply for this grant. The placement can last up to a maximum of 10 weeks, normally during the summer vacation.

2. The Grant will normally provide support at the rate of £160 per week for the student and up to £50 per week for lab costs. The monies will usually be paid to the Department in which the student/graduate works unless a specific request is made for an alternative method of payment.

3. Applications should be made by the supervisor using the PDF form provided on the website or the paper form obtainable from the Society Office.

4. Successful applicants and their students/graduate must write a report on the placement within 4 weeks of completing their placement which will be published in *Microbiologist*. Photographs of the applicant and/or the work done during the placement are desirable. These should be supplied as (a) digital images at a size of not less than 4 inches square at a resolution of not less than 300 pixels per inch, or (b) original photographic prints which will be scanned and promptly returned.

5. Normally a member may not apply for a further grant until a period of two years has elapsed.

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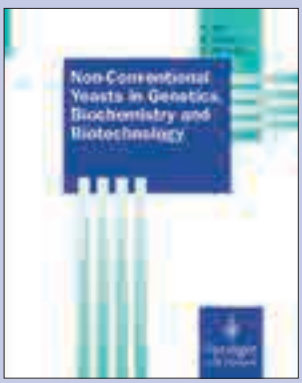

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INTRODUCTION TO FOOD BIOTECHNOLOGY

Perry Johnson-Green
CRC Press (2002)
ISBN 0-8493-1152-7
Reviewed by Rasha Linehan

Introduction to Food Biotechnology covers a wide range of topics relating to Food Biotechnology, including Plant Biotechnology, Animal Biotechnology and Genetics. It serves as an introductory text for undergraduate students who may not have a strong molecular biology and/or genetics background. The book discusses biotechnology within the context of human nutrition, food production, and food processing.

The book is divided into nine chapters, some of which are more thorough than others. The first two chapters introduce the reader to basic concepts of Biotechnology, Microbiology and Genetics. This is very useful to refresh students' memories of basic theories that they may have learnt at the start of their course. Chapter three covers the full area of gene cloning in detail, providing some basic, but useful figures and diagrams, which are very clear and complement the text nicely and while the area of gene cloning can seem complicated, the author has explained it very clearly and concisely in this chapter.

Written from a food production perspective, this book is comprehensive in its description of a wide variety of processes used in food biotechnology. These processes include the use of Microbial products as food or food additives, the importance of Fungi to the food industry, and Genetic Modification (GM) of plant DNA. I was particularly impressed by the section of plant Biotechnology, in chapter 4, on making transgenic plants, as it clearly outlines the process step by step. In addition, the applications of transgenic plants to food production were very relevant and gave numerous accurate examples of the use of GM in foods. Whereas this section of the book did not address the issues surrounding food safety and consumer protection, chapter nine offered a brief discussion of safety issues and regulation policies, such as labelling regulations, transgenic crops, in addition to trade and consumer issues and ethical concerns,

without forming a bias opinion.

Animal Biotechnology is covered briefly in chapter five, with a number of clear flow charts to demonstrate some essential processes in genetic engineering, including the production of 'knock out' mice, which is a widely used tool in medical research. A number of important diagnostic systems are discussed in chapter six, including commonly used techniques, such as the Polymerase Chain Reaction (PCR), Enzyme-Linked Immunosorbent assay (ELISA), and the recently established technique of DNA Microarray Analysis, together with their applications.

Cell Culture and Food is discussed in detail in chapter seven, with particular emphasis on brewing, dairy biotechnology and microbial enzymes, while chapter eight covers industrial, large-scale, cell culture. These chapters are of particular relevance to food industry and give a very good overview of the processes used in food biotechnology.

This book, unlike many other similar publications, offers the reader a simple, yet comprehensive overview of food biotechnology and places emphasis on some of the most important consumer issues surrounding food production and processing, as well as food safety. The book is also well indexed allowing the reader to concentrate on chapters that may be of particular interest.

Rapid and on-line instrumentation for Food Quality Assurance

Ibtisam E. Tothill (Ed.)
Woodhead Publishing Limited (2003)
ISBN 1-85573-674-8
Reviewed by Karl Mc Donald

The use of the phrase food-quality is open to wide interpretation. Quality can mean different things to different people. When I first read the title of this book I was expecting a text dealing primarily with instrumentation which could aid the food industry in developing better techniques for on-line / real time examination of product quality as it is related to attributes such as colour, taste, aroma and texture.

However, the first thing that struck me on opening the book is the fact that it is divided into two distinct sections dealing with product safety and product quality. While the back cover of the book does indicate its safety section, I found the title of the book somewhat misleading as it only mentions quality and unfortunately for the authors possibly diminishes the books potential audience.

That aside, the book is very comprehensive and well written. Following a brief introduction to the structure of the book we move into the first part, which deals with product safety. Here, the reader is presented with nine chapters dealing with techniques for the rapid detection of contaminates such as pesticides, drug resides, foreign bodies and toxins in foods. Additional chapters also deal with rapid methods for detection of microbial contamination in foods and water.

The second part of the book with ten chapters considers methods for identifying ingredients such as food additives and genetically modified ingredients in foods. Remaining chapters bring together methods for monitoring and controlling product quality and composition.

Overall the level of detail given in the book is impressive. The information is as relevant, comprehensive and up-to date as any text I have read in this field. The figures and tables as presented are clear and concise. However, I did find some of the photographic plates used in the text to be of poor quality. The provision in each chapter of sources of further information was a welcome addition.

While it is indicated that the book is a valuable reference for the food industry and provides a benchmark of good practice, I felt that the book was more of an academic reference than an industrial one. That said the book could still offer the food industry a wealth of information.

I was somewhat surprised that the book did not cover the subject of product recall and traceability in the food industry and associated instrumentation. Considering the impending legislative requirements on the food industry in Europe to have food traceability systems in place before January 1st 2005 *(i.e. Regulation [EC] 178/2002)* and the recent issues in relation to food traceability, notably BSE and beef, I felt it was a topic which deserved greater attention in the text.

Reference to some of the legislative requirements and controls on the food industry in Europe was mentioned in general throughout the text. However, I did feel the book lacked the inclusion of a dedicated chapter, which specifically dealt with the legal issues facing the food industry.

There are many other publications that deal with specific aspects of instrumentation for food quality assurance. However, this book is a good generic text for academia, students and anyone in the food industry with an interest in developing technologies to determine and maintain food quality.

The interface between innate and acquired immunity

Various Authors: Edited by M D Cooper and H. Koprowski
Springer-Verlag. 2002
ISBN 3-540-42894-1. Price £46 ($69)
Reviewed by Adam K A Wright

My first impression upon seeing a book bearing this title was that it would highlight and explain the meeting places for where both innate and acquired immunological pathways would interact. It did not do this *per se*, but then the book appears not to have been written with this aim in mind.

This first edition has arisen from a meeting between European and North American investigators in Malta, apparently close to where Ilya Metchnikoff recognised phagocytosis in starfish larvae (an apt place indeed!). In addition it forms part of a series of books in the *Current Topics in Microbiology and Immunology* catalogue. It was hoped that the conference would, as well as communicating recent findings, help to reduce the complexity behind this topic, to which I am sure other immunologists would testify. Several investigators, who are currently active in each research area, have therefore channelled their efforts in to producing very concise chapters:

1. The Relationship of Inflammation and Initiation of Autoimmune Disease: Role of TNF Superfamily Members

2. Surface Receptors that Regulate NK Cell Function: Beyond the NK Cell Scope

3. Checkpoints in the Regulation of T Helper 1 Responses

4. The Role of Complement in

Innate and Adaptive Immunity

5. Several MHC-Linked Ig Superfamily Genes Have Features of Ancestral Antigen-Specific Receptor Genes

6. Coat Protein Transgenic Papaya: 'Acquired' Immunity for Controlling Papaya Ringspot Virus

7. Fc Receptor Homologs (FcRH1-5) Extend the Fc Receptor Family

A brief glance at these chapters indicates that prior knowledge of immunology is essential before picking up this book. Each chapter contains a very brief background and discussion of the topic with one or two helpful figures (15 throughout the whole book). However, unless the reader has experience in looking at flow cytometry analysis and phylogenetic trees, these too will appear quite complex. The comprehensive nature and list of references available make it an excellent starting point for research into each chapter's topic — though admittedly many students will find this book very hard going in places.

Chapter 1 contains a rather more focussed discussion on the initiation of insulitis than its title would otherwise suggest, perhaps due to its support by the Juvenile Diabetes Foundation International and American Diabetes Association. In addition to NK cells, chapter 2 also encompasses myeloid cells and cytotoxic T lymphocytes which receive comparatively greater coverage throughout this book than those cell types covered in chapter 3 together with the various roles of Interleukin (IL) -1α, IL-12 and IL-18. Chapter 4 is an excellent starting point for anyone working in the complement field. Chapters 5, 6 and 7 are best left for those working in that specific field, although the interesting story of Papaya Ringspot Virus demonstrates the importance of foresight and action (as well as success) in research on the Papaya fruit industry in Hawaii (a major exporter of Papaya to the USA, Canada and Japan).

Though the title encompasses a fascinating broad cross-section and will get the attention of many, those not working directly within the subject field of the chapters will be put off perhaps by the price and focussed subject matter. Its major selling point is that it occupies a niche not covered by many other books. It is the latter point, I think, which will increase its appeal to many immunologists, whether dealing with humans or plants!

Principles of Genome Analysis and Genomics

S B Primrose and R M Twyman. Third Edition. Blackwell Publishing; Paperback. ISBN 1-40-510-120-2

Reviewed by Steve Forsythe

There are many books being released now on genomics and proteomics ('readingomics') and the core material of 'Principles of Genome Analysis and Genomics' has been on the market for a considerable number of years. The first edition of the book was in 1995 and the second was in 1998. Consequently there has been a 5-year gap until this latest version. During this time there have been considerable developments in this scientific field not least being the human genome sequence in 2001. The main expansion to make the third edition has been to cover comparative and functional genomics, as well as update the proteomics section. It claims to be a step-by-step outline of techniques involved in genome mapping and sequencing and is aimed at the advanced undergraduate.

This is a very descriptive book composed of twelve chapters in 229 pages. Chapters are about fifteen pages long with six-to-eight figures and two tables. Some diagrams were slightly unclear and I found the green shading tiresome after awhile. Each chapter ends with a list of suggested reading (some being described with regard to their particular usefulness), there are also useful website addresses with short descriptions regarding their subject matter. Landmark publications are highlighted for specific discussion, e.g. Donis-Keller (1987) and Fleischmann et. al., (1995). All cited references are at the end of the book. The first chapter is a short overview of the book structure and this is followed by comparisons of genome organisation and structure in prokaryotes and eukaryotes. Various approaches to subjects are explained along with their limitations. For example for DNA sequencing the Sanger method is described and not Maxam-Gilbert. Whereas pyrosequencing and hydridization-microassays are covered for their specific usefulness. The next four chapters cover genome sequencing (mapping, sequencing, comparative and structural).

Global expression profiling, mutant libraries and mapping protein interaction are separate chapters. Sequencing genomes with and without gene maps are initially emphasized and serve to explain data mining, comparative genomics and annotation. The book ends with consideration of applications of genome analysis and genomics.

If you or your students want to know about aspects of genomics then this book will enable you to gain a broad understanding and provide suitable reading lists and websites for more in-depth articles. It gives the student a good background to the development of not only genomics, but the supporting areas of bioinformatics, the Internet and the influences of the human genome project. It tries to walk the fine line between giving the reader a greater awareness of techniques by providing sufficient information but at the same time does not become so technical that only a specialist would understand it.

If you are looking for a text specific to microbial systems then you may find this book unsuitable due to the broadness of material covered. This may therefore limit its usefulness for undergraduate teaching. However, genomics and proteomics are generic techniques and undergraduates should be aware of this. Although I am hesitant in recommending it for undergraduate microbiology students I would recommend it for Masters students.

Antibiotics actions, origins and resistance

Christopher Walsh. ASM Press, American Society for Microbiology ISBN: 1-55581-254-6

Reviewed by Anna McElhatton

My first thought on seeing the table of contents was simply *'what a breath of fresh air'*. This is a book that, as the author himself says, is a result of his interest in the pharmacology of antimicrobial agents, with particular interest towards the natural products with antibiotic activity that are elaborated by microorganisms, to act as chemical weapons on neighbouring bacteria. Those classes of molecules reported to have an impact in human infectious diseases are discussed in the book.

The introduction enables the reader to

rediscover and appreciate this area of pharmacology through a focused retrospective look at antibiotics and the initial concepts that led to their development: The introduction and first section explains how the action of antibiotics can be understood and categorized, both historically and prospectively, by analyzing the way these small molecules interfere selectively with one or more processes central to the survival of bacterial cells. The cidal, and static effect, the distinct microbial targets, and the rationale for antimicrobials' production by microorganisms are discussed. The emergence of resistance and the race against time for new effective agents is also emphasized.

The scene is thus set for the second section which takes a more detailed look at the major classes of antibiotics that have been useful for the treatment of clinical infectious disease in humans. The agents have been grouped into classes in the conventional manner according to their microbial target. The descriptions include details of the biochemical changes that are triggered by the proximity of these antimicrobial agents to various sites on and within microbial cells. Extensive use of figures and tables should help the reader grasp the required information.

Section three of the book deals with the omnipresent issue of resistance to the agents in current use; these were discussed in section two. The way in which antibiotics block specific proteins, how the molecular structure of drugs enables such activity, and the development of bacterial resistance, are also examined. The three major mechanisms discussed are namely the inactivation of the antibiotic, efflux of the antibiotic and modification of the susceptible molecular target. The narrative thus facilitates appreciation of the issue regarding development of resistance that is discussed in the chapters which follow.

In section four the molecular logic of antibiotic biosynthesis, and prospects for broadening the target base were targeted. Chapter eleven is the introduction to the topic. The regulation of antibiotic biosynthesis through signalling in producer organisms is discussed with enough detail about the involvement of microbial genetics to permit the non-geneticist reader to cope with the information. The chapters that follow discuss the biosynthesis of nonribosomal peptide antibiotics and other classes.

In section five, specifically in chapter 15, new targets are mentioned and discussed as is the involvement and use of genomics as a targeting tool. Chapter 16 deals with the new molecules available and chapter 17 brings together the prevailing issues and challenges associated with the use of new antibiotics

After reading through the book, I am convinced that this is a text for the Pharmaceutical Microbiologist who likes to keep abreast with the current trends in the field. Furthermore, it should make a good reference text for specialists in other areas who need specific information about current trends in Molecular microbiology and Pharmacology.

At less than sixty pounds (£60) it is good value. It is not a beginners' book; one hopes that a text introducing these issues will soon also be available to undergraduate students at large. If not, one hopes that at least snippets of information in this book would reach undergraduate classes as a result of their mentors' appreciation of the body of knowledge presented in this text.

Instant notes: Microbiology

J Nicklin, K Graeme-Cook and R Killington. 2nd Edition
BIOS Scientific Publishers, Taylor & Francis Group (2002)
ISBN:1-85996-267-X. Price: £16.99
Reviewed by Sibel Roller

This book is part of the "Instant Notes" series of textbooks aimed at science undergraduates and designed to facilitate rapid learning and revision. Unlike many classical microbiology textbooks on the market, this book is compact enough to fit neatly into a rucksack without risking back injury. At the same time, the 330 pages are packed with a wealth of comprehensive information for the budding microbiologist in a format that is easy to read and understand. At £16.99, it represents excellent value for money and should be affordable by most students.

After a very brief introduction to the microbial world, the book is divided into seven broadly equal sections on microbial metabolism; information storage and transfer; bacterial structure and function; bacterial genetics; bacteria and *Archaea* in the environment; eukaryotic microorganisms; and the *Chlorophyta* and *Protista*. The final section on viruses is twice the size of the others and includes a very topical chapter on prions and transmissible spongiform encephalopathies. Each section is sub-divided into chapters of approximately five or six pages each. Every chapter begins with a box defining and explaining key concepts. These boxes are reminiscent of a computer screen with 'clickable' buttons in the left margin and more detailed explanations in the main body of the box. This format is bound to appeal to today's computer-literate student. All the chapters are liberally illustrated with black-and-white line diagrams, as well as chemical structures and formulae and the occasional photograph. Key technical terms are clearly explained. There is an abundance of bulleted and numbered lists, all of which should help with rapid learning. Whilst the presentation of the material in bite-sized chunks may not appeal to the hardened academic, the approach is ideal for the student suffering from information overload. The book concludes with a short but pertinent 'Further Reading' list and a useful index.

Most of the important areas are covered in the book but, as might be expected of an introductory textbook, the depth of coverage is somewhat variable. For example, biotechnologists and food microbiologists will find only four pages on industrial microbiology and fermented foods in the book.

My only (slight) reservation about the book is that the order in which the different sections are presented may be problematic for those first year undergraduates without any prior knowledge of microbiology. For example, Table 2 in the introduction (page 3) comparing prokaryotic with eukaryotic cells is full of jargon. The technical terms in this table are explained very well later on in the book but may be daunting for the novice confronted with them for the first time. A simple diagram could ease the student into the subject more gently, with the more comprehensive table presented later on in the book. However, with careful guidance from the tutor, the students' reading of the book could be tailored to match different backgrounds and interests. Overall, I would recommend this textbook to academic colleagues teaching microbiology.

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CONTACT:

Society for Applied Microbiology, The Blore Tower, The Harpur Centre, Bedford MK40 1TQ, UK
Tel: 01234 326661
Fax: 01234 326678
email: info@sfam.org.uk
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membership options

■ **Full membership** gives online access to the ***Journal of Applied Microbiology***, ***Letters in Applied Microbiology*** and ***Environmental Microbiology***, copies of ***Microbiologist***, preferential registration rates at Society meetings and access to the members areas of the website.

■ **Full student membership** confers the same benefits as Full Membership at a specially reduced rate for full time students not in receipt of a taxable salary.

■ **Associate membership** this new class of membership is open to all current and new Society members including existing Associate Student Members and Retired members and gives quarterly copies of ***Microbiologist*** and preferential registration rates at all Society meetings.

■ **Honorary Membership** of the Society is by election only and this honour is conferred on persons of distinction in the field of applied microbiology.

■ **Corporate membership** is open to all companies with an interest in microbiology. Corporate members benefits include:

- Online access to the Society's three journals OR hard copies of the journals.
- Half page advertisement in each quarterly issue of ***Microbiologist*** (which can be upgraded to a larger size at very attractive discounted rates).
- Full page advertisement in the Members' Handbook.
- FREE banner advert on the Society Website with a direct link to your company site.
- Up to three members of company staff attending Society meetings at members' rate. (This means a 50% discount on non member registration rate).

Meetings

We hold two annual meetings. The January Meeting comprises discussion sessions with the opportunity to display posters on related work. The Summer Conference is held every July and comprises a main symposium, a poster session, the AGM and a lively social programme. We also hold occasional joint ventures with other organisations on topics of mutual interest.

Publications

The Society publishes two monthly journals: ***Journal of Applied Microbiology*** and ***Letters in Applied Microbiology.*** We also produce our own quarterly in-house colour magazine: ***Microbiologist***, which contains features, reports topical news stories and full details of our meetings. The Society is also a partner with Blackwell Publishing in the bi-monthly journal ***Environmental Microbiology.***

Online journals

Synergy is an online service provided by Blackwell Publishing that gives Full and Student Members **FREE** access to the online versions of the Society's three journals: ***Journal of Applied Microbiology***, ***Letters in Applied Microbiology*** and ***Environmental Microbiology***. Members can register for this service at http://www.blackwell-science.com. Members can also submit papers directly to our journals via an online submission service.

For more information about Synergy or online manuscript submission, please visit the website.

Grants & awards

Many awards and prizes are available to members including the **W H Pierce Memorial Prize** and Prizes for Student Oral Presentations and Posters at the Summer Conference. In addition to these substantial awards, the Society has funds to assist members in their careers as microbiologists. These include **The President's Fund**, Conference Studentships, Sponsored Lectures and the popular **Students into Work** Scheme.

Full details of all the Society's grants and awards can be found on the website together with easy-to-use online application forms.

Special interests

The Society has six very active Interest Groups:

■ Bioengineering, ■ Educational Development, ■ Environmental, ■ Food Safety and Technology, ■ Infection, Prevention and Treatment, ■ Molecular Biology

Detailed information about these Groups can be found on the Society website.


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